



**Draft Guidelines for Quantifying
the
Environmental Benefits
of
An Investment Analysis**

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1 INTRODUCTION

EPA [1] states, “air pollution causes a wide variety of health effects that range from eye irritation, to heart and lung damage, to premature death. It can also impair visibility and reduce crop production, as well as damage ecosystems, national parks, wilderness areas, and water bodies”. This study further identifies “planes” as a mobile source of air pollution along with cars and trains. Other source of air pollution include “stationary sources” such as factories, power plants, and smelters, and “natural sources” such as wildfires, windblown dust, and volcanic eruptions.

The Council of the International Civil Aviation Organization (ICAO) reports that aircraft engine emissions may be contributing to climate change. It further states that jets emit CO₂, and NO_x, which, at higher altitudes, contribute to global warming.

EPA [8] attributes 0.6 to 3.6 percent of 1990 total regional mobile sources of NOx to commercial jet aircraft. This study further suggests that this percentage is growing and estimates that it will be between 1.9% and 10.4% by 2010. Similarly, EPA [7] attributes 1 to 3 percent of regional air pollution inventories to airport-related air pollution. Airport-related air pollution is produced by aircraft operations, landside vehicle operations and aircraft ground support equipment.

Benefit analyses conducted for any investment analysis (IA) include the overall benefits of a new system. The identified benefits may include fuel reductions due to delay reductions or the acquisition of the ability to fly shorter, more optimal routes. In most of these cases, the IA team may also claim environmental benefits due to fuel savings which result in emissions reductions.

This paper describes techniques to quantify changes in emissions due to technological improvements. The emissions of primary concern included in this study are:

- 1) Carbon Dioxide (CO₂),
- 2) Nitrogen Oxides (NO_x),
- 3) Carbon Monoxide (CO),
- 4) Hydrocarbons (HC)
- 5) Sulfur Dioxide (SO₂).

Moreover, these gases, in the presence of other chemicals, are the primary sources of:

- Ground-level ozone (O₃)
- Particulate Matter (PM-10)
- Visibility impairment
- Global Warming and Climate Change

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- Acid Rain

Appendix A provides short descriptions of all of the above, their causal factors and their impacts on public health, ecosystems, national parks, wilderness areas, and water bodies.

Aviation fuel may contain other emittants such as lead (Pb), which are not discussed in this paper. Furthermore, quantifying emissions which result from the aircraft's own Auxiliary Power Unit (APU) or the Ground Support (GSE) in general are not considered in this paper.

It is the authors' understanding that environmental benefits have been discussed qualitatively in some past IAs, but have not been quantified. Thus, this paper does not include examples from any historical Investment Analysis work in this area.

2 ENVIRONMENTAL BENEFITS

2.1 Beneficiaries of Environmental Benefits

Environmental benefits have been categorized as societal benefits [6]. Unlike efficiency or most safety benefits, the global public at large benefits from reductions in emissions, as opposed to just airlines, the flying public and other users. Moreover, our management of the environment greatly affects the livability of the earth for generations to come.

2.2 Which Technologies (Projects) Can Claim This Benefit?

Any procedural changes or Communication Navigation Surveillance/Air Traffic Management (CNS/ATM) system that results in any of the following may generate environmental benefits.

1. Reduction in en-route, taxi-out, taxi-in or approach delays. Approach delay is defined as air holds in the "last tier" due to congestion at the destination airport.
2. More efficient flights due to shorter, more direct routes, wind optimized flight trajectories or cruise climb/descent

Some of the relevant technologies are:

- Data link
- Automatic Dependent Surveillance-Broadcast (ADS-B)
- Free Flight Phase I
- Wide Area Augmentation System/Local Area Augmentation System (WAAS/LAAS)

2.3 Environmental Benefits Can Be Quantified But Not Monetized

Fuel savings resulting from delay reductions or efficient flights are usually monetized as reductions in Aircraft Direct Operating Costs (ADOC).

It is the authors' understanding that neither the airlines nor the flying public face any monetary penalty for emissions.

2.4 Possible Environmental Dis-benefits

More efficient flights or delay reductions can result in cheaper tickets, more competition and more flights, leading to aviation industry growth. If the benefit analyses include such business cases and monetize airlines' profit increases due to growth in number of flights, then one has to quantify the dis-benefit of additional fuel consumption and emissions.

Similarly, in the baseline case (i.e., do nothing), if one considers reduction in aviation growth (a dis-benefit) due to longer delays and flight times, then one has to capture the environmental benefits obtained from the reduction of the number of flights or their growth rate.

3 HOW TO QUANTIFY BENEFITS

Benefits (reduction in fuel consumption or emissions) can arise when the system under study reduces delays or flight times, or results in better optimized flights. Fuel consumption reductions also reduce emissions in general.

3.1 Simulation Approach

NASPAC has a postprocessor that estimates fuel consumption and HC, CO and NO_x emissions by flight. This postprocessor uses aircraft performance to calculate fuel burn for each flight. A force balance equation is applied to aircraft for which detailed aircraft performance data are available from LINKMOD [4] data. For those aircraft types without performance data, fuel burn is calculated in a manner similar to the Breguet [5] equations. For detailed description of the force balance equation applied to aircraft without performance data, see [2]. Doug Baart, <mailto:Douglas.Baart@faa.gov>, can be contacted for more information on the NASPAC postprocessor.

3.2 A Parametric Approach

This section describes how to quantify fuel and emissions savings given the delay or flight time reductions using the results of a parametric approach. Moreover, ways to adjust for fuel efficiency improvements resulting from engine improvements and changes in fleet mix is also discussed. The underlying methodology of this parametric approach can be found in [3].

3.2.1 Description

Fuel consumption varies drastically by phase of flight, so each phase should be studied separately. These phases of flight are Surface, Take Off, Initial Climb, Cruise and Approach.

Definitions:

Cruise: Portion of flight above 3000 feet.

Approach: Final approach at destination airport, below 3000 feet.

Climb: Initial climb below 3000 feet.

Take off: Portion of flight that starts from lift-off from the runway and ends at Climb.

Surface: Portion of flight that occurs on the ground: taxi-in and taxi-out.

Aircraft engine improvements and fleet mix changes can influence fuel burn. As aircraft are retired and replacements are purchased, the newer models tend to have lower fuel usage and reduced emissions. Subsection 3.2.2, Step 8, discusses adjustments for fleet mix changes and engine improvements.

3.2.2 Steps for Quantifying Environmental Benefits

Eight steps are required to quantify environmental benefits. As mentioned above, environmental benefits estimation should be done after quantifying the efficiency benefits.

The step numbers do not match the steps identified in Cohen [6], “General Guidelines for Conducting the Benefits Analysis Portion of an Investment Analysis.” Cohen [6] provides general guidance while this section focuses on computing environmental benefits.

Step 1: Identify the Applicability of Environmental Benefit

Calculate efficiency benefits such as the average percent or absolute delay reduction delay reduction per flight or the percent flight time reduction. In general, whenever cost reductions exist, so do reductions in fuel consumption and emissions. However, there are cases that reduction in flight time actually increases fuel consumption.

Step 2: Identify the Areas of Application

- Using the definitions in section 3.2.1, identify the phases of flight in which the saving occurs. For example, reduction in taxi-out delay occurs during the surface phase of flight.
- Identify the airports, types of aircraft (if applicable) and class(es) (e.g., air carriers or GA only) to which the technology is applicable.

Step 3: Data Sources

Select one or several representative days of flights using

- ETMS, if the efficiency benefit is applicable to all IFR GA flights.
- CODAS
 - Note that CODAS does not include international flights arriving at or departing from any U.S. airports. Furthermore, it does not include GA flights.
- OAG
 - Only includes scheduled flights but does contain international flights.
- ASQP
 - Includes 10 major air carriers reporting to the DOT system only.
 - Other possible data sources are given in [6].

If historical or simulation data are used to calculate the average delay reduction per flight, then use the same data source for the rest of the analysis.

Step 4: Gathering and Processing the Data

- Using step 3, get the number of flights for each city pair by aircraft type.
- Filter the data to include only the pieces that are relevant. For example, if system X reduces taxi-out delay at 6 airports, then include data only for those 6 departure airports.
- ICAO provides fuel and emissions (HC, CO and NO_x) coefficients for the surface, climb, approach and take-off phases of flight. FAA [2] maps over 180 aircraft types to ICAO's engines. Table 1 lists these aircraft types. Use Table 3, obtained from FAA[3], to map all other unknown aircraft types to known ones. This table maps all unknown aircraft types to BE58. If the table does not include an aircraft type of interest, then
 - Use other sources such as [13] to find an aircraft with similar engines.
 - GA flights may be mapped to BE58.

Step 5: Calculating Fuel Consumption and CO, HC and NO_x Emissions

Multiply the number of flights by average delay reduction times in minutes to obtain the appropriate coefficients found in tables 4-11 to calculate total fuel and emissions savings.

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Below 3000' and Surface

For phases of flights below 3000': surface (Table 4), takeoff (Table 5), climb (Table 6) and approach (Table 7), the same coefficients are used for the baseline and all alternative cases. The savings come from the minutes saved.

The average take off, climb and “unimpeded” approach times are .7, 2.2 and 4 minutes, respectively. Make sure that the minutes of reduction claimed are reasonable and certainly not higher than the above numbers.

Example:

Suppose technology X reduces average taxi-out delays by 1.2, 2.1, 3.4 minutes, according to the low, most likely and high estimates, respectively, at airport Y. Also suppose that, on average, six Boeing 757 (B757) flights leave airport Y per day. Use Table 3 to map B757 to B757-200. The fuel and emissions coefficients for the B757-200 can be found in Table 4 as follows:

		Emissions Coefficients (lb/1000lb Fuel)			
Aircraft	Fuel (lb/min/engine)	HC	CO	NOx	# of Engines
B757-200	0.19	1	15.44	4.3	2

Most likely estimates:

1. First calculate the total fuel reduction using the equation,

Total fuel reduction = (fuel coefficient) * (number of engines) * (number of flights)
* (most likely delay savings per flight).

In this example, the calculation is

$$.19 * 2 * 6 * 2.1 = 4.788 \text{ lbs.}$$

2. Next, the emissions reductions for each emittant are calculated using the equation

Emission reduction = (total fuel reduction) * (emittant coefficient) / 1000

In this example,

$$\text{CO reduction} = 4.788 * 15.44 / 1000 = .0739 \text{ lb}$$

$$\text{NO}_x \text{ reduction} = 4.788 * 4.3 / 1000 = .02058 \text{ lb}$$

$$\text{HC reduction} = 4.788 * 1 / 1000 = .0048 \text{ lb}$$

Low and High estimates are made in the same way, using the Low and High delay reduction estimates, respectively.

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Above 3000' (cruise phase)

At present, ICAO does not provide fuel burn or emission coefficients for cruise phase above 3000 feet for different engine types. FAA [3] used the CONUS simulation results [2] to estimate fuel burn and emission coefficients for different aircraft type. The coefficients provided herein are taken directly from FAA [3]. This study is in draft format and is currently under review by the Committee on Aviation Environmental Protection (CAEP) of the International Civil Aviation Organization (ICAO) and members of various other international organizations.

Since aircraft emissions vary by altitude, FAA [3] provide emission coefficients for different scenarios. Thus, one cannot simply use minutes saved to calculate emissions reductions. Instead, the total fuel burn per aircraft type should be obtained for the baseline (no enhancements) and alternative scenarios. Then, total emissions by type should be calculated using different coefficients for each scenario. Finally, reductions in emissions by type are obtained by differencing each pair of numbers.

Currently available fuel burn coefficients [3] are the same for the baseline and optimized cases. These statistics are based on averages for all altitudes above 3000 feet. Table 8 lists these fuel burn coefficients. Please note that:

- These coefficients are already adjusted for the number of engines. Thus, one should multiply the proper coefficient by the number of flights and average flight time to obtain total fuel saving for the cruise above 3000' portion of flight.
- A range of coefficients, low, median, average and high are provided. Thus, the analyst can obtain a range of estimates by combining these ranges with the flight time ranges. For example if low, most likely and high estimates exist for cruise portion of flights, one can obtain as many as 12 estimates for total fuel burn savings.
- The coefficients for calculating fuel consumption are the same for the baseline and optimal cases. The savings come from shorter flights. One should calculate total fuel burn consumption by aircraft type and then proceed to calculate emissions savings.
- Above 3000', the emission coefficients vary by altitude. Several coefficient tables are provided for different scenarios.
 - Use Table 10 if
 - Flights flying less than 1,000 nautical miles have their distances reduced (direct routing) when operating at FL240 and above.
 - Flights flying greater than 1,000 nautical miles were optimized for minimum fuel when operating at FL240 and above.
 - Use Table 11 if

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- Flights flying less than 1,000 nautical miles have their distances reduced (direct routing) when operating at 15,000 feet and above.
- Flights flying greater than 1,000 nautical miles are optimized for minimum fuel when operating at 15,000 feet and above.
- Use Table 9 for the baseline scenario or any other scenario if none of the above rules apply.

Example:

Technology X reduces flight time above 3000' by enabling wind-optimized direct routes above 15,000 feet and cruise climb and descent for city pair (Y, Z). The average cruise time, (above 3000') between Y and Z is 145 minutes for all Boeing 757. The average flight time is the average of all B757 aircraft leaving Y and arriving at Z and flights leaving Z and arriving at Y. Assume this technology reduce cruise time by 1% to 3%. Thus, flight time for the alternative scenario is between 141 and 144 minutes. On average, 6 flights operate daily between Y and Z of aircraft type Boeing 757. From Table 8 the fuel burn rates per minutes are

AC TYPE	Average (lbs/min)	Median (lbs/min)	Low Rank (lbs/min)	High Rank (lbs/min)
B757-200	124.43	119.91	114.16	131.74

- Calculate the fuel consumption

Baseline: Use the median fuel burn rate of 119.91 lbs./min. to obtain

$$\text{Total fuel burn} = 145 * 119.91 * 6 = 104,322 \text{ lbs.}$$

Alternative: Using the median fuel burn rate and 3% flight time reduction to obtain

$$\text{Total fuel burn} = 141 * 119.91 * 6 = 101,444 \text{ lbs.}$$

Here, 6 is the number of flights and 145 and 141 are the average length of cruise time for the baseline and alternative scenarios, respectively.

- Calculate the emissions

For the baseline case use Table 9

AC Type	Emissions Coefficients (lbs./1000lbs. Fuel)		
	NOx	CO	HC
B757-200	16.233	7.8059	0.6694

Baseline case:

$$\text{Total NO}_x \text{ emissions} = 104,322 * 16.233 / 1000. = 1703 \text{ lbs.}$$

$$\text{Total CO emissions} = 104,322 * 7.8059 / 1000 = 814 \text{ lbs.}$$

$$\text{Total HC emissions} = 104,322 * 0.6694 / 1000 = 70 \text{ lbs.}$$

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For the alternative scenario use Table 11.

AC Type	Emissions Coefficients (lbs./1000lbs. Fuel)		
	NO _x	CO	HC
B757-200	14.7214	6.556	0.5241

The emissions calculations for the alternative scenario are:

$$\text{Total NO}_x \text{ emissions} = 101,444 * 14.7214 / 1000 = 1493 \text{ lbs.}$$

$$\text{Total CO emissions} = 101,444 * 6.556 / 1000 = 665 \text{ lbs.}$$

$$\text{Total HC emissions} = 101,444 * 0.5241 / 1000 = 53 \text{ lbs.}$$

The fuel burn and emissions reductions are the differences between the alternative and baseline scenarios:

$$\text{Fuel} = 2878 \text{ lbs.}$$

$$\text{NO}_x = 209 \text{ lbs.}$$

$$\text{CO} = 149 \text{ lbs.}$$

$$\text{HC} = 17 \text{ lbs.}$$

Step 6: Calculate CO₂ and SO₂ Reductions

Estimating CO₂ and SO₂ reductions is very easy once fuel reduction is known. All engines produce approximately 3.15 times as much CO₂ as fuel burnt. Likewise, for every 1000 pounds of fuel burnt, .8 pound of SO₂ is produced. These approximations are based on the assumption of complete combustion. Detailed information is in [3] Appendix D.

	Emissions Coefficients		
	CO ₂	H ₂ O	SO ₂ (lb/1000lb Fuel)
All aircraft type	3.15	1.24	.8

The coefficient for water, H₂O, is given for informational purposes. The effects of water at high altitude are unknown at present and are being investigated by environmental engineers. Certainly, on the ground, water is not considered an emittant.

Step 7: Annualize the Forecast Benefits and Emissions Savings for Future Years.

The following steps complete the quantification of environmental benefits.

- Annualize the numbers.
- Repeat for future years
 - Adjust demand (i.e., number of flights) for future using TAF.
 - If applicable, estimate the delays for the future years. Remember that delay, capacity and demand are nonlinearly related. This means that an increase in demand will increase delay by a higher rate. Delay growth can

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be estimated by simulation or analytically approximated. One such approximation [3] uses queueing theory in equilibrium.

Step 8: Adjusting for Fleet Mix

If you have already adjusted for fleet mix while performing a simulation to estimate delays in the out years then skip this step.

Aircraft engine improvements as well as fleet mix changes over time can influence fuel burn. As aircraft are retired and replacements are purchased, the newer models tend to have improved fuel usage and reduced emissions.

The Forecast and Economics Subgroup (FESG) of the International Civil Aviation Organization's (ICAO) Committee in Environmental Protection (CAEP) assumes that this reduction is 1% per year over the next 20 years amounting to a 20% overall reduction. Thus, if you use this method, once you estimate the fuel savings for future years, reduce fuel burn by 1% a year from the base year and then estimate emissions.

The capability of using an alternative methodology as described below is described in [3]. This is added as an option to estimate fuel burn and emission reduction due to engine efficiency. This methodology uses the current year's fleet growth rate and age of aircraft to estimate the average age of aircraft for future years. Then, it uses negative exponential equations developed by EUROCONTROL [3] to estimate fuel reduction.

EUROCONTROL [9] uses historical data to correlate the impact of aircraft engine improvements on fuel and emissions reductions. This parametric approach results in a simple negative exponential equation:

$$y = 2E + 25 \cdot \exp(-0.02761 \cdot x)$$

where

x = Year of aircraft purchase

y = Fuel burn reduction in percent

Since x is the year that the aircraft was purchased, to use this equation the average aircraft age for the given year of study is needed. For example, FESG [10] provides the regional growth rate by class of aircraft. The average age of aircraft for the current year can be calculated using [11] or [13]. ATA [12] provides forecasts of the ratios of added and removed aircraft. These sources are used to calculate the average age for any given year:

$$((aa_{k-1} + 1) \cdot na_{k-1} - ra_k \cdot aar + da_k) / na_k$$

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where

- aa_k = Average age of aircraft in year k
- na_k = Number of aircraft in year k
- ra_k = Number of aircraft retired from operations in year k
- da_k = Number of aircraft added to operations in year k
- aar = Average age of aircraft at retirement, assumed to be 25

The number aircraft added in year k , na_k , is calculated as:

$$\begin{cases} \frac{na_{k-1} \cdot gw_k \cdot rar_k}{rar_k - 1} & \text{where } rar_k \neq 1 \\ na_{k-1} \cdot gw_k & \text{otherwise} \end{cases}$$

The number of aircraft retired in year k is estimated as:

$$\begin{cases} \frac{na_{k-1} \cdot gw_k}{rar_k - 1} & \text{where } rar_k \neq 1 \\ 0 & \text{otherwise} \end{cases}$$

where

- gw_k = Fleet growth rate in year k , from FESG [3]

and

- rar_k = Forecast ratio of added to retired aircraft in year k , from ATA [12].

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APPENDIX A

A.1 INTRODUCTION

The following sections provide a short description of, CO, HC, NOx, CO₂, SO₂, Acid rain, visibility impairment, global warming, ground level ozone and Particulate Matter (PM-10), the causal factors and the impact on peoples health , ecosystems, national parks, wilderness areas, and water bodies. Most of these descriptions are taken from EPA study [1].

A.2 CARBON MONOXIDE (CO)

“Carbon monoxide is a colorless, odorless, poisonous gas formed when carbon in fuels is not burned completely. It is a byproduct of highway vehicle exhaust which contributes about 60 percent of all CO emissions nationwide.”

“Carbon monoxide enters the bloodstream and reduces oxygen delivery to the body's organs and tissues. The health threat from exposure to CO is most serious for those who suffer from cardiovascular disease. Healthy individuals are also affected, but only at higher levels of exposure. Exposure to elevated CO levels is associated with visual impairment, reduced work capacity, reduced manual dexterity, poor learning ability, and difficulty in performing complex tasks.”

A.3 HYDROCARBON (HC)

Aviation fuel is composed primarily of hydrocarbons, molecules containing both hydrogen and carbon. Due to incomplete combustion, hydrocarbons (HC) in the forms of unburnt or partially burnt fuel are emitted into the atmosphere. HC is a subset of Volatile Organic Compounds (VOC). EPA lists VOC as one of the six principal air pollutants. The other five are carbon monoxide, lead, nitrogen dioxide, particulate matter, and sulfur dioxide. VOC plays a major role in the atmospheric reactions that produce ground-level ozone and other photochemicals which constitute smog.

A.4 NITROGEN DIOXIDE (NO₂)

“Nitrogen dioxide (NO₂) belongs to a family of highly reactive gases called nitrogen oxides (NOx). These gases form when fuel is burned at high temperatures, and come principally from motor vehicle exhaust and stationary sources such as electric utilities and industrial boilers. A suffocating, brownish gas, nitrogen dioxide is a strong oxidizing agent that reacts in the air to form corrosive nitric acid, as well as toxic organic nitrates. It also plays a major role in the atmospheric reactions that produce ground-level ozone (or smog).”

“Nitrogen dioxide can irritate the lungs and lower resistance to respiratory

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infections such as influenza. The effects of short-term exposure are still unclear, but continued or frequent exposure to concentrations that are typically much higher than those normally found in the ambient air may cause increased incidence of acute respiratory illness in children". "Nitrogen oxides contribute to ozone formation and can have adverse effects on both terrestrial and aquatic ecosystems. Nitrogen oxides in the air can significantly contribute to a number of environmental effects such as acid rain and eutrophication in coastal waters like the Chesapeake Bay. Eutrophication occurs when a body of water suffers an increase in nutrients that leads to a reduction in the amount of oxygen in the water, producing an environment that is destructive to fish and other animal life."

A.5 SURLFUR DIOXIDE (SO₂)

"Sulfur dioxide belongs to the family of gases called sulfur oxides (SOx). These gases are formed when fuel containing sulfur (mainly coal and oil) is burned, and during metal smelting and other industrial processes."

"The major health concerns associated with exposure to high concentrations of SO₂ include effects on breathing, respiratory illness, alterations in pulmonary defenses, and aggravation of existing cardiovascular disease. Children, the elderly, and people with asthma, cardiovascular disease or chronic lung disease (such as bronchitis or emphysema), are most susceptible to adverse health effects associated with exposure to SO₂." "SO₂ is a precursor to sulfates, which are associated with acidification of lakes and streams, accelerated corrosion of buildings and monuments, reduced visibility, and adverse health effects."

A.6 GROUND-LEVEL OZONE (O₃)

"Ground-level ozone (the primary constituent of smog) is the most complex, difficult to control, and pervasive of the other air pollutants. Unlike other pollutants, ozone is not emitted directly into the air by specific sources. Ozone is created by sunlight acting on NOx and Volatile Organic Compounds (VOC) in the air. There are thousands of types of sources of these gases. Some of the common sources include gasoline vapors, chemical solvents, combustion products of fuels, and consumer products. Emissions of NOx and VOC from motor vehicles and stationary sources can be carried hundreds of miles from their origins, and result in high ozone concentrations over very large regions."

"Scientific evidence indicates that ground-level ozone not only affects people with impaired respiratory systems (such as asthmatics), but healthy adults and children as well. Exposure to ozone for 6 to 7 hours, even at relatively low concentrations, significantly reduces lung function and induces respiratory inflammation in normal, healthy people during periods of moderate exercise. It can be accompanied by symptoms such as chest pain, coughing, nausea, and pulmonary congestion. Recent studies provide evidence of an association between elevated ozone levels and increases in hospital admissions for

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respiratory problems in several U.S. cities. Results from animal studies indicate that repeated exposure to high levels of ozone for several months or more can produce permanent structural damage in the lungs". "Ozone is responsible for approximately 1 to 2 billion dollars of agricultural crop yield loss in the U.S. each year. Ozone also damages forest ecosystems in California and the eastern U.S. "

A.7 PARTICULATE MATTER (PM-10)

"Particulate matter is the term for solid or liquid particles found in the air. Some particles are large or dark enough to be seen as soot or smoke. Others are so small they can be detected only with an electron microscope. Because particles originate from a variety of mobile and stationary sources (diesel trucks, woodstoves, power plants, etc.), their chemical and physical compositions vary widely. Particulate matter can be directly emitted or can be formed in the atmosphere when gaseous pollutants such as SO₂ and NO_x react to form fine particles. "

A.8 ACID RAIN

"Acidic deposition or "acid rain" occurs when emissions of sulfur dioxide (SO₂) and oxides of nitrogen (NO_x) in the atmosphere react with water, oxygen, and oxidants to form acidic compounds. These compounds fall to the Earth in either dry form (gas and particles) or wet form (rain, snow, and fog). Some are carried by the wind, sometimes hundreds of miles, across State and national borders."

"Before falling to Earth, SO₂ and NO_x gases and related particulate matter (sulfates and nitrates) contribute to poor visibility and impact public health. Major human health concerns associated with their exposure include effects on breathing and the respiratory system, damage to lung tissue, cancer, and premature death. In the environment, acid rain raises the acid levels of lakes and streams (making the water unsuitable for some fish and other wildlife) and damages trees at high elevations. It also speeds up the decay of buildings, statues, and sculptures, including those that are part of our national heritage."

"Reductions in SO₂ and NO_x will decrease levels of sulfates, nitrates, and ground-level ozone (smog), leading to improvements in public health and other benefits such as better water quality in lakes and streams. Visibility will also improve, enhancing the beauty of our country's scenic vistas, including those in national parks. Likewise, damage to the trees that populate mountain ridges from Maine to Georgia will be reduced, and deterioration of our historic buildings and monuments will be slowed."

A.9 VISIBILITY IMPAIRMENT

"Visibility impairment occurs as a result of the scattering and absorption of light by particles and gases in the atmosphere. It is most simply described as the haze

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which obscures the clarity, color, texture, and form of what we see. The same particles which are linked to serious health effects [sulfates, nitrates, organic carbon, soot (elemental carbon), and soil dust] can significantly affect our ability to see."

"In many parts of the U.S., sulfates are the largest single contributor to haze. Data from this monitoring network reveal that sulfates account for approximately two-thirds of the visibility reduction in the Appalachian Mountains in the East. Organic carbon, the next-largest contributor, causes about 15 percent of visibility reduction. In most areas of the western U.S. and Alaska, sulfates and organic particles contribute equally to haze. In southern California, nitrate particles are the greatest contributor to haze."

"[Reduction in Acid Rain], SO₂ emissions, which are expected to lead to improvements in visibility impairment caused by sulfate haze, particularly in the eastern U.S. Better controls on NOx sources also can improve regional visibility conditions."

A.10 GLOBAL WARMING AND CLIMATE CHANGE

"The Earth's climate is fueled by the Sun. Most of the Sun's energy, called solar radiation, is absorbed by the Earth, but some is reflected back into space. A natural layer of atmospheric gases absorbs a portion of this reflected solar radiation, eventually releasing some of it into space, but forcing much of it back to Earth. There it warms the Earth's surface creating what is known as the natural *greenhouse effect* ."Without the natural greenhouse effect, the Earth's average temperature would be much colder, and the planet would be covered with ice. Recent scientific evidence shows that the greenhouse effect is being increased by release of certain gases to the atmosphere that cause the Earth's temperature to rise. This is called "global warming." Carbon dioxide (CO₂) accounts for about 85 percent of greenhouse gases released in the U.S. Emissions of NOx and VOC contribute to the formation of ground-level ozone or smog, also a greenhouse gas."

"Greenhouse gas emissions could cause a 1.8 to 6.3° Fahrenheit rise in temperature during the next century, if atmospheric levels are not reduced. Although this change may appear small, it could produce extreme weather events, such as droughts and floods; threaten coastal resources and wetlands by raising sea level; and increase the risk of certain diseases by producing new breeding sites for pests and pathogens. Agricultural regions and woodlands are also susceptible to changes in climate that could result in increased insect populations and plant disease. This degradation of natural ecosystems could lead to reduced biological diversity."

APPENDIX B

Table B-1: List of Known Aircraft Types.

mapped to ICAO engine type. See [2] for details.

Known Aircraft Type					
BE58	BA46	C130	DA01	IL96	PA41
F16	AT42	C141	DA02	KC35	PA46
F18	BE60	C152	DA05	KE35	PARO
A300	B1	C172	DA10	KR35	PASE
B727-200	C23	C177	DA20	L1011	PAYE
B73S	BE18	C182	DC10-30	L188	PAZT
B757-200	BE30	C206	DC3	L1F	S20
B767-200	B52	C208	DC6	LR35	SF34
B777	BE20	C210	DC86	LR24	SH7
A10	BE02	CA21	DC9-50	L329	SHD3
A6	BE33	CL61	DH2	L382	SW3
AJ25	BE35	C310	DH3	LR60	SW4
B747-200	BE55	C340	DH6	LR31	T1
A320	B707	C401	E110	LR25	T34
A310	B74F	C402	E120	LR55	T2
A4	B74R	C414	N265	MO20	T37
AA5	BA31	C425	E2	M1F	T38I
PA31	BA11	C441	EA6	MD11	TA4
AC69	BA14	C5	FK10	MD88	
TU34	BA41	C500	F14	MU2	
TU5	BATP	C501	F15	MU3	
U21	BE10	C550	FA28	MU30	
UH1	BE36	C560	FA27	N22B	
UH60	BE3B	C650	FK70	NEWX	
WW24	BE40	C9	FFJ	PA34	
YK4	BE76	CRJ	G2	P3	
YS11	BE8T	CL44	G159	PA32	
AC50	BE90	CL60	PA28	PA42	
C421	BE99	CONC	G3	PA60	
DH8	C21	CV58	G4	PA23	
ARJ	BN2	D28	G73	PA24	
AN12	C12	D328	HS25	PA30	

Environmental Benefit

Environmental Benefit

Table B-2: Mapping of Aircraft Types to ICAO/BM2 Engine Types.

Type	Name	Manufacturer	ICAO Default Engine	BM2 Default Engine	Engines
A10	A-10A THUNDERBOLT II	FAIRCHILD REPUBLIC	TFE731-2-2B	LRJ/	2
A300	AIRBUS-300	AIRBUS	CF6-80C2A5	A30B2-100/CF6-50C2R	2
A310	AIRBUS-310	AIRBUS	CF6-80A3	A31-200/CF6-80A3	2
A320	AIRBUS-320	AIRBUS	CFM56-5-A1	A32-200/CFM56-5A1	2
A4	A4	DOUGLAS	TFE731-2-2B	LRJ/	1
A6	A6	GRUMMAN	TFE731-2-2B	LRJ/	2
AA5	CHEETAH AA-5	GRUMMAN	IO-360-B		1
AC50	COMMANDER 500	AERO COMMANDER	IO-360-B		2
AC69	JET PROP COMMANDER	AERO COMMANDER	PT6A-65B	BE1/SMTURB	2
AJ25	ASTRA 1125-IW	ISRAEL	TFE731-2-2B	LRJ/	2
AN12	AN-12	ANTONOV	501D22A		4
ARJ	AVRO REGIONAL JET	AERO	CF34-3A		2
ATR42	AIR TRACTOR-42	AIR TRACTOR	PW120	AT4/LGTURB	2
B1	B1 LANCER	ROCKWELL	JT3D-3B		4
B52	STRATOFORTRESS	BOEING	JT3D-3B		8
B707	BOEING 707-100/200/300/400	BOEING	JT3D-3B	B3C-320CH/JT3D-3B	4
B727	BOEING 727	BOEING	JT8D-15(REC)	72S-200/JT8D-15	3
B727-100	BOEING 727-100	BOEING	JT8D-7B (R.E.C.)	727-100/JT8D-7B	3
B727-200	BOEING 727-200	BOEING	JT8D-15(REC)	72S-200/JT8D-15	3
B737	BOEING 737-100/200 SERIES	BOEING	JT8D-15(REC)	737-200/JT8D-15	2
B737-200	BOEING 737-200	BOEING	JT8D-15(REC)	737-200/JT8D-15	2
B73F	BOEING 737-400	BOEING	CFM56-3C-1	73Z-400/CFM56-3B	2
B73J	BOEING 737-500	BOEING	CFM56-3C-1	73L-500/CFM56-3C	2
B73S	BOEING 737-300/400 SERIES	BOEING	CFM56-3-B1	73Y-300/CFM56-3B	2
B747	BOEING 747	BOEING	JT9D-7Q	747-200B/JT9D-7Q	4
B747-100	BOEING 747-100	BOEING	JT9D-7A	747-100/JT9D-7A	4
B747-200	BOEING 747-200	BOEING	JT9D-7Q	747-200B/JT9D-7Q	4

Environmental Benefit

Type	Name	Manufacturer	ICAO Default Engine	BM2 Default Engine	Engines
B74F	BOEING 747-400	BOEING	PW4056	74I-400/PW4056	4
B74R	BOEING 747-R	BOEING	PW4056	74I-400/PW4056	4
B757	BOEING 757	BOEING	RB211-535E4	757-200/RB211-535E4	2
B757-200	BOEING 757-200	BOEING	RB211-535E4	757-200/RB211-535E4	2
B767	BOEING 767	BOEING	CF6-80A	767-200/CF6-80A	2
B767-200	BOEING 767	BOEING	CF6-80A	767-200/CF6-80A	2
B777	BOEING 777	BOEING	PW4084		2
BA11	BRITISH AIRCRAFT -111	BRITISH AIRCRAFT	SPEY MK511	BAC-500/RR_SPEY-512	2
BA14	BRITISH AIRCRAFT - 14	BRITISH AIRCRAFT	SPEY MK511	BAC-500/RR_SPEY-512	2
BA31	BAE JETSTREAM-31	BAE	PT6A-65B	BE1/SMTURB	2
BA41	BAE JETSTREAM-41	BAE	PT6A-65B	BE1/SMTURB	2
BA46	BAE 146-200	BAE	ALF 502R-5	146-200/ALF502R-5	4
BATP	BAE ADVANCED TURBOPROP	BAE	PT6A-65B	BE1/SMTURB	2
BE02	BEECH 1900-C	BEECH	PT6A-65B	BE1/SMTURB	2
BE10	BEECH-10 KING AIR 100	BEECH	IO-360-B		2
BE18	BEECH-18 TWIN	BEECH	O-200		1
BE20	BEECH-20 SUPER KING AIR HURON	BEECH	IO-360-B		2
BE30	BEECH-30 SUPER KING AIR 300	BEECH	PT6A-65B	BE1/SMTURB	2
BE33	BEECH-33 BONANZA 33	BEECH	IO-360-B		1
BE35	BEECH-35 BONANZA 35	BEECH	O-200		1
BE36	BEECH-36 BONANZA 36	BEECH	IO-360-B		1
BE3B	BEECH SUPER KING AIR 350	BEECH	PT6A-65B	BE1/SMTURB	2
BE40	BEECH JET 400	BEECH	CJ610-6	LRJ/	2
BE55	BEECH BARON 55/CHOCHISE	BEECH	IO-360-B		2
BE58	BEECH BARON 58	BEECH	IO-360-B		2
BE60	BEECH DUKE 60	BEECH	IO-360-B		2
BE76	BEECH DUCHESS 76	BEECH	IO-360-B		2
BE8T	BEECH	BEECH	IO-360-B		2

Environmental Benefit

Type	Name	Manufacturer	ICAO Default Engine	BM2 Default Engine	Engines
BE90	BEECH KING AIR C-90	BEECH	IO-360-B		2
BE99	BEECH AIRLINER 99	BEECH	IO-360-B		2
BN2	BN-2A/B ISLANDER	BRITTEN-NORMAN	IO-360-B		2
BN3	BN-2A MARK III TRISLANDER	BRITTEN-NORMAN	IO-360-B		3
C12	C-12 HURON	CESSNA	PT6A-45	BEK/SMTURB	2
C130	C-130 HERCULES	CESSNA	501D22A		4
C141	C-141 STARLIFTER	CESSNA	TF33-P-3		4
C152	CESSNA-152 ACROBAT	CESSNA	O-200		1
C172	CESSNA SKYHAWK CUTLASS	CESSNA	O-200		1
C177	CESSNA CARDINAL 177	CESSNA	O-200		1
C182	CESSNA SKYLANE 182/RG TURBO/RG	CESSNA	O-200		1
C206	CESSNA STATIONAIR 6/TURBO 6	CESSNA	O-200		1
C208	CESSNA CARAVAN I 208-A	CESSNA	PT6A-65B	BE1/SMTURB	1
C21	CESSNA - 21	CESSNA	TFE731-2-2B	CNJ/	2
C210	CESSNA -210 CENTURION/II	CESSNA	O-200		1
C23	CESSNA - 23	CESSNA	TFE731-2-2B	CNJ/	2
C310	CESSNA - 310	CESSNA	IO-360-B		2
C340	CESSNA - 340	CESSNA	IO-360-B		2
C401	CESSNA - 401	CESSNA	IO-360-B		2
C402	CESSNA BUSINESSLINER	CESSNA	IO-360-B		2
C414	CESSNA - 414 CANCELLOR	CESSNA	IO-360-B		2
C421	CESSNA - 421 GOLDEN EAGLE	CESSNA	IO-360-B		2
C425	CESSNA - 425 CORSAIR/CONQUEST	CESSNA	IO-360-B		2
C441	CESSNA - 441 CONQUEST II	CESSNA	IO-360-B		2
C5	C- 5 GALAXY	CESSNA	JT9D-7Q	747-200B/JT9D-7Q	4
C500	CESSNA - 500 CITATION I	CESSNA	CJ610-2C	CNJ/	2
C501	CESSNA - 501 CITATION I-SP	CESSNA	CJ610-2C	CNJ/	2

Environmental Benefit

Type	Name	Manufacturer	ICAO Default Engine	BM2 Default Engine	Engines
C550	CESSNA - 550 CITATION II/S2	CESSNA	CF34-3A		2
C560	CESSNA - 560 CITATION III/650	CESSNA	CF34-3A		2
C650	CESSNA - 650 CITATION III	CESSNA	CF34-3A		2
C9	C-9 NIGHTINGALE	CESSNA	JT8D-7 SERIES (REC)	D9S-30/JT8D-7B	2
CA21	CASA - 212 AVIOCAN	CASA	PT6A-65B	BE1/SMTURB	2
CL44	YUKON FREIGHTLINER	CANADAIR/BOMBARDIER	CT7-5	SF3/MDTURB	4
CL60	CHALLENGER 600	CANADAIR/BOMBARDIER	CF34-3A		2
CL61	CHALLENGER - 610	CANADAIR/BOMBARDIER	CF34-3A		2
CONC	CONCORDE	CONCORDE	OLYMPUS 593 MK610	Concorde	4
CRJ-200	CANADAIR REGIONAL JET	CANADAIR	CF34-3A		2
CV58	CONVAIR 580	CONVAIR	PT6A-65B	BE1/SMTURB	2
D28	DONIER 28	DONIER	PT6A-65B	BE1/SMTURB	2
D328	DONIER 328	DONIER	PW120	DH8/MDTURB	2
DA01	MERCURE 100 - C	DASSAULT	JT8D-7 SERIES (REC)	D9S-30/JT8D-7B	2
DA02	FALCON 20/C	DASSAULT	CF34-3A		2
DA05	MYSTERE FALCON 50	DASSAULT	CF34-3A		3
DA10	FALCON DA - 10	DASSAULT	TFE731-2-2B	LRJ/	2
DA20	FALCON 20	DASSAULT	CF34-3A		3
DC10	DOUGLAS - 10	MCDONNELL DOUGLAS	CF6-6D	D10-10/CF6-6D	3
DC10-10	DOUGLAS 10-10	MCDONNEL DOUGLAS	CF6-6D	D10-10/CF6-6D	3
DC10-30	DOUGLAS 10-30	MCDONNELL DOUGLAS	CF6-50C2	DLR-30/CF6-50C2	3
DC3	SKYTRAIN	MCDONNEL DOUGLAS	PT6A-65B	BE1/SMTURB	2
DC6	DOUGLAS - 6	MCDONNEL DOUGLAS	501D22A		4
DC8-63	DOUGLAS 8-63	MCDONNEL DOUGLAS	JT3D-7 (SERIES)	D8S-63H/JT3D-7	4
DC86	DOUGLAS -86	MCDONNEL DOUGLAS	JT8D-7 SERIES (REC)	D8C-33F/JT4A-11	4
DC9	DC - 9 NIGHTINGALE/SKYTRAIN II	MCDONNEL DOUGLAS	JT8D-7 SERIES (REC)	D9S-30/JT8D-7B	2
DC9-30	DC - 9-30	MCDONNEL DOUGLAS	JT8D-7 SERIES (REC)	D9S-30/JT8D-7B	2
DC9-50	DC - 9-50	MCDONNEL DOUGLAS	JT8D-17	D9X-50/JT8D-17	2
DH2	BEAVER DHC - 2	DEHAVILLAND	IO-360-B		1

Environmental Benefit

Type	Name	Manufacturer	ICAO Default Engine	BM2 Default Engine	Engines
DH3	OTTER DHC - 2	DEHAVILLAND	PW120	DH3/MDTURB	1
DH6	TWIN OTTER DHC - 6	DEHAVILLAND	PT6A-45	SH6/MDTURB	2
DH8	DASH 8	DEHAVILLAND	PW120	DH8/MDTURB	2
E110	BANDEIRANTE EMB - 110	EMBRAER-EMPRESA BRASILEIR	PT6A-45	EMB/SMTURB	2
E120	BRASILIA EMB - 120	EMBRAER-EMPRESA BRASILEIR	PW118	EMB/SMTURB	2
E2	HAWKEYE	GRUMMAN	PW125B	F50/LGTURB	2
EA32	AIRBUS A - 320	AIRBUS	CFM56-5-A1	A32-200/CFM56-5A1	2
EA33	AIRBUS 330	AIRBUS	CF6-80E1A2		2
EA34	AIRBUS 340	AIRBUS	CFM56-5C2		4
EA6	EA6	GRUMMAN	TFE731-2-2B	LRJ/	2
F14	TOMCAT	GRUMMAN	TF30-P-412A(JFT 10A)		2
F15	EAGLE	BOEING	F100-PW-100		2
F16	FIGHTING FALCON	LOCKHEED	F100-PW-100		2
F18	HORNET	MCDONNEL DOUGLAS	F100-PW-100		2
FA27	FRIENDSHIP F-27	FAIRCHILD	CF34-3A		2
FA28	FRIENDSHIP F-28	FAIRCHILD	SPEY MK555	F28-4000/RR_SPEY-MK555	2
FK10	FOKKER 100	FOKKER	TAY MK620-15	F10-100/TAY620-15	2
FK50	FOKKER 50 TWIN-TURBOPROP	FOKKER	PW125B	F50/LGTURB	2
FK70	FOKKER 70	FOKKER	TAY MK620-15	F10-100/TAY620-15	2
G159	GAC 159-C GULFSTREAM I	GULFSTREAM	PW125B	F50/LGTURB	2
G2	GULFSTREAM II	GULFSTREAM	CF34-3A		2
G3	GULFSTREAM III	GULFSTREAM	CF34-3A		2
G4	GULFSTREAM IV	GULFSTREAM	CF34-3A		2
G73	MALLARD	GRUMMAN	PW120	DH8/MDTURB	2
HS25	HAWKER SIDDLEY	BAE	CF34-3A		2
IL62	IL - 62 CLASSIC	ILYUSHIN	CFM56-5C2	I62/SOL	4
IL76	IL - 76 CANDID	ILYUSHIN	PW4056	I72/	4
IL96	ILYUSHIN II - 96M	ILYUSHIN	PW4056	I86/KUZ	4

Environmental Benefit

Type	Name	Manufacturer	ICAO Default Engine	BM2 Default Engine	Engines
KC35	STRATOTANKER KC - 135	BOEING	JT9D-7Q	747-200B/JT9D-7Q	4
KE35	STRATOTANKER KC - 135E	BOEING	JT9D-7Q	747-200B/JT9D-7Q	4
KR35	STRATOTANKER KC 135 R	BOEING	JT9D-7Q	747-200B/JT9D-7Q	4
L101	TRI-STAR, ALL SERIES	LOCKHEED	RB211-22B (REV.)	L10-1/RB211-22B	3
L1011	L - 1011	LOCKHEED	RB211-22B (REV.)	L10-1/RB211-22B	3
L188	ELECTRA 188	LOCKHEED	501D22A		4
L1F	TRI-STAR 101F	LOCKHEED	RB211-22B (REV.)	L10-1/RB211-22B	3
L329	JETSTAR	LOCKHEED	TF33-P-3		4
L382	HERCULES (130)	LOCKHEED	501D22A		4
L4T	ORION/AURORA	LOCKHEED	PT6A-65B	L4T/SMTURB	2
LR24	LEARJET - 24	LEAR	CJ610-2C	LRJ/	2
LR25	LEARJET - 25	LEAR	CJ610-6	LRJ/	2
LR31	LEARJET - 31	LEAR	TFE731-2-2B	LRJ/	2
LR35	LEARJET - 35	LEAR	TFE731-2-2B	LRJ/	2
LR55	LEARJET - 55	LEAR	TFE731-2-2B	LRJ/	2
LR60	LEARJET - 60	LEAR	TFE731-2-2B	LRJ/	2
M1F	MD - 11F	MCDONNELL DOUGLAS	PW4460	MDL-11P/PW4460	3
MD11	MD - 11	MCDONNELL DOUGLAS	CF6-80C2D1F	MDL-11P/PW4460	3
MD80	MD - 80	MCDONNELL DOUGLAS	JT8D-217	D9Z-82/JT8D-217	2
MD88	MD - 88	MCDONNELL DOUGLAS	JT8D-217	D9Z-82/JT8D-217	2
MD90	MD - 90	MCDONNELL DOUGLAS	V2525-D5		2
MO20	MOONEY MK - 20	MOONEY	IO-360-B		1
MU2	MITSUBISHI MU - 2	MITSUBISHI	PT6A-65B	MU2/SMTURB	2
MU3	MITSUBISHI DIAMOND I/300	MITSUBISHI	CJ610-6	LRJ/	2
MU30	MITSUBISHI 300 DIAMOND	MITSUBISHI	CJ610-6	LRJ/	2
N22B	N 22B - NOMAD	AEROSPACE TECHNOLOGIES	PT6A-65B	BE1/SMTURB	2
N265	SABRELINER - 65	ROCKWELL	JT8D-7 SERIES (REC)	D9S-30/JT8D-7B	2
NEWX	NEW CLASS 6 JET		PW4056	741-400/PW4056	4
P3	ORION	LOCKHEED	501D22A		4
PA23	APACHE	PIPER	O-200		2

Environmental Benefit

Type	Name	Manufacturer	ICAO Default Engine	BM2 Default Engine	Engines
PA24	COMANCHE	PIPER	O-200		1
PA28	CHEROKEE ARCHER DAKOTA-WARRIOR	PIPER	O-200		1
PA30	TWIN COMANCHE	PIPER	IO-360-B		2
PA31	CHIEFTAN MOHAVE NAVAJO T-1020	PIPER	PT6A-45	SH6/MDTURB	2
PA32	CHEROKEE SIX LANCE SARATOGA	PIPER	IO-360-B		1
PA34	SENECA	PIPER	IO-360-B		2
PA41	CHEYENNE	PIPER	PT6A-45	SH6/MDTURB	2
PA42	CHEYENNE III/IV 400 LS	PIPER	PT6A-45	PA6/SMTURB	2
PA46	MALIBU	PIPER	IO-360-B		1
PA60	AEROSTAR 600/700	PIPER	IO-360-B		2
PARO	CHEROKEE ARROW IV	PIPER	O-200		1
PASE	SENECA	PIPER	IO-360-B		2
PAYE	CHEYENNE II	PIPER	PT6A-45	SH6/MDTURB	2
PAZT	250 AZTEC	PIPER	IO-360-B		2
S20	S20	AEROSPATIALE	PT6A-65B	BE1/SMTURB	2
SF34	SF - 340 A	SAAB	CT7-5		2
SH7	SHORTS SC-7 SKYVAN	SHORTS BROTHERS	PW120	SH6/MDTURB	2
SHD3	SHORTS SH - 360	SHORTS BROTHERS	501D22A		2
SW3	METRO III MERLIN IVC	FAIRCHILD	TPE 331-3		2
SW4	METRO II/A	FAIRCHILD	TPE 331-3		2
T1	T1 JAYHAWK	RAYTHEON	CJ610-6	LRJ/	2
T2	BUCKEYE T-20	ROCKWELL	TFE731-2-2B	LRJ/	2
T34	MENTOR	BEECH	IO-360-B		1
T37	T-37 TWEET	CESSNA	CJ610-6	LRJ/	2
T38I	T38 TALON	GRUMMAN	TFE731-2-2B	LRJ/	2
TA4	TA4	MCDONNELL DOUGLAS	TFE731-2-2B	LRJ/	1
TU34	TU - 134	TUPOLEV	CF34-3A	T34/SOL	2

Environmental Benefit

Type	Name	Manufacturer	ICAO Default Engine	BM2 Default Engine	Engines
TU5	TU - 154	TUPOLEV	CF34-3A		2
U21	UTE	BEECH	PT6A-65B	BE1/SMTURB	2
UH1	IROQUOIS	BELL HELICOPTER TEXTRON	T53-L-11D		1
UH60	UH 60	BELL HELICOPTER	T53-L-11D		1
WW24	WESTWIND 2	ISRAEL	TFE731-2-2B	LRJ/	2
YK4	YAK - 42	YAKOVLEV	D-36		2
YS11	YS-11A	NIHON	CF34-3A		2

Environmental Benefit

Table B-3: Mapped Unknown Aircraft Type to Known one

Unknown Aircraft	Mapped to																
0815	BE58	AA5	AA5	AT45	AT42	B741	B74F	BE40	BE40	C17R	C172	C650	C650	DA21	DA20		
0W3	BE58	AA5A	AA5	AT72	AT42	B742	B74F	BE50	BE55	C180	C182	C69	C23	DA22	DA20		
1F16	F16	AA5B	AA5	ATLA	AT42	B743	B74F	BE55	BE55	C182	C182	C72R	C172	DA50	DA20		
25C	BE58	AA7	AA5	ATP	BA46	B744	B74F	BE58	BE58	C185	C182	C72T	C172	DA90	DA20		
2CL4	BE58	AC11	AA5	ATR	BA46	B747	B747-200	BE60	BE60	C18R	C182	C750	BE58	DC10	DC10-30		
2F18	F18	AC12	AA5	AV8	AJ25	B747-200	B747-200	BE65	BE60	C2	C12	C77R	BE58	DC10-30	DC10-30		
2T38	BE58	AC14	AA5	AV8B	AJ25	B74A	B747-200	BE76	BE76	C20	C206	C82R	BE58	DC3	DC3		
328	BE58	AC2A	AA5	B06	BE60	B74B	B74F	BE77	BE76	C201	C206	C9	C9	DC6	DC6		
332	A300	AC50	AC50	B1	B1	B74F	B74F	BE80	BE8T	C205	C206	C90	C9	DC8	DC86		
34	BE58	AC60	AC69	B100	BE58	B74R	B74R	BE8T	BE8T	C206	C206	CA21	CA21	DC85	DC86		
35	BE58	AC68	AC69	B12	BE58	B74S	B74R	BE9	BE90	C207	C208	CA7	CA7	DC86	DC86		
38A	BE58	AC69	AC69	B17	C23	B752	B757-200	BE90	BE90	C208	C208	CARJ	CRJ	DC87	DC86		
421	BE58	AC6T	AC69	B18T	BE58	B753	B757-200	BE95	BE90	C21	C21	CE43	C560	DC8S	DC86		
46	BE58	AC80	AC69	B19	BE18	B757	B757-200	BE99	BE99	C210	C210	CE56	C560	DC9	DC9-50		
5215	BE58	AC84	AC69	B190	BE30	B757-200	B757-200	BE9C	C21	C212	C210	CH47	BE58	DC9-50	DC9-50		
6123	BE58	AC90	AC69	B2	B52	B762	B767-200	BE9F	C21	C23	C23	CL21	CL44	DE10	BE58		
727	B727-200	AC95	AC69	B20	BE20	B763	B767-200	BE9G	C21	C25	C23	CL22	CL44	DH2	DH2		
736	B73S	ACT	AC50	B200	BE02	B767	B767-200	BE9L	C21	C26	CA21	CL2T	CL44	DH3	DH3		
737	B73S	AE32	C421	B206	DH8	B767-200	B767-200	BE9T	C21	C27	C23	CL41	CL44	DH6	DH6		
737B	B73S	AEST	C421	B222	BE20	B772	B777	BEL9	DH8	C208	C208	CL44	CL44	DH7	DH8		
757	B757-200	AFTR	BE58	B337	BE33	B773	B777	BELF	BE10	C303	CL61	CL60	CL60	DH8	DH8		
767	B767-200	AG3	BE58	B35	BE35	B777	B777	BEST	BE10	C310	C310	CL61	CL61	DH83	DH8		
773	B777	AG5B	BE58	B350	BE35	B9L	BE58	BH06	BE58	C320	CL61	CL64	CL61	DH8A	DH8		
777	B777	AH1	DH8	B36T	BE35	BA02	BA31	BH12	BE58	C335	CL61	CL65	CL61	DH8B	DH8		
815	BE58	AH1W	BE58	B52	B52	BA10	BA11	BH22	BE58	C336	CL61	CLRJ	CL44	DH8C	DH8		
A1	A10	AH64	DH8	B55	BE55	BA11	BA11	BH41	BE58	C337	CL61	CM11	BE58	DHC	DH8		
A10	A10	AJ25	AJ25	B58	BE58	BA14	BA14	BH43	BE58	C340	C340	CN35	BE58	DHC2	DH8		
A106	A6	AJET	ARJ	B701	B707	BA31	BA31	BHO6	BE58	C401	C401	CNC	BE58	DHC3	DH8		
A109	AJ25	AK76	BE58	B703	B707	BA32	BA31	BJ40	BE58	C402	C402	CONC	CONC	DHC6	DH6		
A124	B747-200	ALOR	BE58	B707	B707	BA41	BA41	BK17	BE58	C404	C402	Concorde	Concorde	DHC7	DH8		
A20	A320	AMX	BE58	B72	B727-200	BA46	BA46	BL17	BE58	C406	C402	CRJ	CRJ	DHC8	DH8		
A300	A300	AN12	AN12	B720	B727-200	BATP	BATP	BL26	BE58	C411	C414	CS12	BE58	DO28	BE90		
A306	A300	AN24	AN12	B721	B727-200	BE02	BE02	BL30	BE58	C414	C414	CS5	C5	DO32	D328		
A30B	A300	AN26	BE58	B722	B727-200	BE10	BE10	BN2	BN2	C42	C421	CV24	WW24	DO38	D328		
A310	A310	AN28	BE58	B727	B727-200	BE18	BE18	BN2P	BN2	C421	C421	CV34	WW24	DO82	DA20		
A319	A320	AN30	BE58	B727-200	B727-200	BE19	BE18	BN2T	BN2	C425	C425	CV44	WW24	DR40	BE58		
A32	A320	AN32	BE58	B73	B73S	BE1L	BE18	BS46	BE58	C440	C441	CV58	CV58	DSH8	BE58		
A320	A320	AN6	AN12	B731	B73S	BE2	BE20	BST	BE58	C441	C441	CV60	CL61	E110	E110		
A321	A320	AN72	BE58	B732	B73S	BE20	BE20	C12	C12	C5	C5	CV64	CL61	E120	E120		
A330	A300	ARCF	BE58	B733	B73S	BE23	BE33	C125	C12	C500	C500	CVLP	BE58	E121	E120		
A340	A320	ARJ	ARJ	B734	B73S	BE24	BE33	C130	C130	C501	C501	CVLT	CV58	E145	N265		
A340-600	A320	AS32	BE58	B735	B73S	BE2H	BE20	C135	C130	C502	C501	D082	BE58	E2	E2		
A3ST	A300	AS50	BE58	B736	B73S	BE3	BE30	C140	C141	C525	C550	D228	D28	E3	C5		
A4	A4	AS55	BE58	B737	B73S	BE30	BE30	C141	C141	C55	C560	D28	D28	E3CF	C5		
A40	A4	AS65	BE58	B738	B73S	BE31	BE30	C150	C152	C550	C560	D328	D328	E3D	C5		
A4F	A4	ASTR	BA46	B73A	B73S	BE33	BE33	C152	C152	C551	C560	D329	D328	E3TF	C5		
A6	A6	AT1	AT42	B73B	B73S	BE35	BE35	C160	C172	C56	C560	DA01	DA01	E6	C5		
A7	A6	AT38	AT42	B73C	B73S	BE36	BE36	C17	C172	C560	C560	DA02	DA02	E9	AJ25		
A748	BE58	AT42	AT42	B73F	B73S	BE3B	BE3B	C172	C172	C56X	C560	DA05	DA05	EA32	AC69		
AA1	AA5	AT43	AT42	B73S	B73S	BE3L	BE30	C175	C177	C580	C560	DA10	DA10	EA34	WW24		
AA22	AA5	AT44	AT42	B74	B74F	BE4	BE40	C177	C177	C60	C650	DA20	DA20	EA6	EA6		

Table B.3. Mapped Unknown Aircraft Type to Known One, Cont'd

Unknown aircraft	Mapped to																
EA6B	EA6	G115	BE58	HU25	BE58	LJ31	LR31	MS76	A10	PA44	PA42	SH33	AJ25	TOR	A10		
EAST	BE58	G159	G159	HW50	BE58	LJ34	LR35	MT35	BE58	PA46	PA46	SH36	SH7	TRIN	BE58		
EC35	BE58	G2	G2	HXA	BE58	LJ35	LR35	MU2	MU2	PA56	PA60	SH6	SH7	TRIS	PA31		
EH60	BE58	G21	N265	HXB	BE58	LJ36	LR35	MU2B	MU2	PA60	PA60	SH7	SH7	TS60	AC69		
ER2	AJ25	G222	PA28	HXC	BE58	LJ39	LR35	MU2P	MU2	PAAT	PA60	SHD3	SHD3	TS61	AC69		
ES3	BE58	G3	G3	HXE	BE58	LJ45	LR35	MU3	MU3	PARO	PARO	SJ20	BE58	TU34	TU34		
F100	FK10	G4	G4	IL18	C130	LJ5	LR55	MU30	MU30	PASE	PASE	SK76	BE58	TU5	TU5		
F104	FK10	G5	CL60	IL62	B707	LJ55	LR35	MXT7	BE58	PAT4	PA42	SRB1	BE58	TUCA	TU5		
F111	A4	G73	G73	IL76	IL96	LJ60	LR60	N22B	N22B	PAY1	PA42	STAR	C421	TYPE	BE58		
F117	F18	GA7	BE20	IL86	IL96	LR23	LR24	N260	N265	PAY2	PA42	SW2	SW3	U2	U21		
F14	F14	GC1	BE58	IL96	IL96	LR24	LR24	N262	N265	PAY3	PA42	SW2A	SW3	U21	U21		
F15	F15	GL20	BE58	J328	BE58	LR25	LR25	N265	N265	PAY4	PA42	SW3	SW3	UH1	UH1		
F16	F16	GL25	N265	JCOM	BE58	LR31	LR31	NA1	BE58	PAYE	PAYE	SW39	SW3	UH60	UH60		
F16C	F16	GLF2	N265	JS20	BA46	LR35	LR35	NA4	BE58	PAZT	PAZT	SW4	SW4	UNK	BE58		
F18	F18	GLF3	N265	JS31	BA46	LR36	LR35	NEWX	NEWX	PC12	AC69	T1	T1	V35B	BE58		
F20	BE58	GLF4	N265	JS32	BA46	LR45	LR35	NIM	BE58	PC6	AC69	T114	BE58	VC10	BE58		
F24	FA28	GLF5	N265	JS41	BA46	LR55	LR55	P180	C421	PC6P	AC69	T134	T34	WA42	BE58		
F26	FA28	GOLF	N265	JST	BA46	LR60	LR60	P210	PA34	PC6T	AC69	T154	TU5	WB57	BE58		
F260	FA28	GULF	N265	JSTA	BA46	M020	MO20	P28	BA31	PC7	AC69	T2	T2	WL	BE58		
F27	FA27	GY80	N265	JSTB	BA31	M02J	MO20	P28A	BA31	PC9	BE58	T20	T2	WW1	BE58		
F28	FA28	H1	DH8	JSTR	BA46	M1F	M1F	P28B	BA31	PL12	BE58	T204	T2	WW2	WW24		
F2TH	BE58	H25	BE58	K35A	KC35	M20	M1F	P28R	BA31	PROP	BE58	T210	T2	WW23	WW24		
F33	FA28	H25A	HS25	K35E	KC35	M201	M1F	P28T	BA31	PUMA	BE58	T303	T34	WW24	WW24		
F4	F18	H25B	HS25	K35R	KC35	M20C	M1F	P3	P3	R100	BE58	T31T	T34	WWP	WW24		
F406	BE58	H25C	HS25	KC10	B707	M20F	M1F	P31	G159	R300	BE58	T33	C23	Y42	YK4		
F50	N265	H46	C23	KC13	KC35	M20J	M1F	P31P	G159	R90R	BE58	T34	T34	YK18	YK4		
F60	FK70	H47	BE20	KC35	KC35	M20K	M1F	P31T	G159	RALL	BE58	T34P	T34	YK4	YK4		
F70	FK70	H53	BE20	KE35	KE35	M20M	M1F	P32	PA32	RC12	BE58	T34T	T34	YK40	YK4		
F90	BE30	H53E	BE20	KR35	KR35	M20P	M1F	P32R	PA32	RV6	BE58	T37	T37	YK42	YK4		
F900	BE30	H57	AJ25	L101	L1011	M20R	M1F	P32T	PA32	S05R	S20	T38	T38I	YN7	BE58		
FA02	FA27	H60	BE20	L180	L188	M20T	M1F	P34	PA34	S2	S20	T38I	T38I	YS11	YS11		
FA10	FA28	H64	BE20	L188	L188	M339	M1F	P3C	P3	S20	S20	T39	T38I	Z42	B73S		
FA18	F18	H65	BE20	L1F	L1F	MD11	MD11	P42	PA42	S226	S20	T44	T34	ZZZ	B73S		
FA20	FA27	HAR	A4	L200	LR35	MD80	MD88	P66T	PA60	S3	AJ25	T45	F18				
FA22	FA27	HB2	BE58	L235	LR35	MD82	MD88	P68	PA60	S360	S20	T6	T37				
FA27	FA27	HB25	BE58	L24	LR24	MD83	MD88	P808	PA60	S601	S20	T700	BE58				
FA28	FA28	HC25	HS25	L24J	LR24	MD87	MD88	PA16	PA23	S61	S20	TA4	TA4				
FA30	BE58	HC5	BE58	L29A	CL60	MD88	MD88	PA22	PA23	S65	S20	TA42	TA4				
FA50	FA27	HDC8	BE58	L29B	CL60	MD90	MD88	PA23	PA23	S65C	BE58	TAMP	TA4				
FA90	BE30	HELO	BE58	L329	L329	MF17	M1F	PA24	PA24	S76	C560	TB10	BE58				
FAF	FA27	HERN	BE58	L382	L382	MG29	F18	PA25	PA24	SA20	BE58	TB20	BE58				
FD90	BE58	HF20	BE58	L39	L382	MH53	M1F	PA27	PA28	SA27	BE58	TB21	BE58				
FFJ	FFJ	HH60	AJ25	L40	LR60	MIR2	F18	PA28	PA28	SB20	BE58	TB30	BE58				
FJ20	N265	HK17	BE58	L410	LR60	ML7	BE58	PA30	PA30	SBR	BE58	TB40	BE58				
FJ50	BE58	HM17	BE58	L4T	LR60	MO2	MO20	PA31	PA31	SBR1	FA27	TB7	BE58				
FK10	FK10	HOT	BE58	L60	LR60	MO20	MO20	PA32	PA32	SBRI	FA27	TB70	BE58				
FK27	FA27	HPR7	BE58	LJ23	LR24	MO21	MO20	PA34	PA34	SC7	BE58	TBM	BE58				
FK28	FA27	HS25	HS25	LJ24	LR24	MO2J	MO20	PA38	PA34	SD3	BE58	TBM7	BE58				
FK50	N265	HS28	HS25	LJ25	LR31	MO2K	MO20	PA39	PA34	SF20	S20	TC12	BE58				
FK70	FK70	HS45	HS25	LJ26	LR25	MRC	A10	PA41	PA41	SF34	SF34	TEST	BE58				
G1	G2	HS74	N265	LJ28	LR35	MRF1	A10	PA42	PA42	SH3	AJ25	TOBA	BE58				

Environmental Benefit

Environmental Benefit

Table B-4: Surface
ICAO Fuel and emissions coefficients by aircraft type.

Surface :	Known Aircraft	Emissions Coefficients (lb/1000lb Fuel)				# of Engines
		Fuel (lb/min/engine)	HC	CO	NOx	
A10		0.024	20.04	58.6	2.82	2
A300		0.205	1.48	18.89	4.76	2
A310		0.15	6.28	28.2	3.4	2
A320		0.1011	1.4	17.6	4	2
A4		0.024	20.04	58.6	2.82	1
A6		0.024	20.04	58.6	2.82	2
AA5		0.001	49.2	897.4	1.16	1
AC50		0.001	49.2	897.4	1.16	2
AC69		0.0217	22	66	2.9	2
AJ25		0.024	20.04	58.6	2.82	2
AN12		0.0769	17.61	43.6	3.52	4
ARJ		0.0496	3.95	42.6	3.82	2
AT42		0.04	0	14.9	5.7	2
B1		0.135	112	98	25	4
B52		0.135	112	98	25	8
B707		0.135	112	98	25	4
B727-200		0.1477	1.46	11	3.2	3
B73S		0.114	2.28	34.4	3.9	2
B747-200		0.237	12	53	3	4
B74F		0.208	1.92	21.86	4.8	4
B74R		0.208	1.92	21.86	4.8	4
B757-200		0.19	1	15.44	4.3	2
B767-200		0.15	6.29	28.2	3.4	2
B777		0.242	2.7	18.7	4.4	2
BA11		0.119	56.73	97.96	1.48	2
BA14		0.119	56.73	97.96	1.48	2
BA31		0.0217	22	66	2.9	2
BA41		0.0217	22	66	2.9	2
BA46		0.0408	5.39	40.93	3.78	4
BATP		0.0217	22	66	2.9	2
BE02		0.0217	22	66	2.9	2
BE10		0.001	49.2	897.4	1.16	2
BE18		0.001	29	644.4	1.58	1
BE20		0.001	49.2	897.4	1.16	2
BE30		0.0217	22	66	2.9	2

Environmental Benefit

Surface :		Emissions Coefficients (lb/1000lb Fuel)			# of Engines
		HC	CO	NOx	
Known Aircraft	Fuel (lb/min/engine)				
BE33	0.001	49.2	897.4	1.16	1
BE35	0.001	29	644.4	1.58	1
BE36	0.001	49.2	897.4	1.16	1
BE3B	0.0217	22	66	2.9	2
BE40	0.064	18	155	0.9	2
BE55	0.001	49.2	897.4	1.16	2
BE58	0.001	49.2	897.4	1.16	2
BE60	0.001	49.2	897.4	1.16	2
BE76	0.001	49.2	897.4	1.16	2
BE8T	0.001	49.2	897.4	1.16	2
BE90	0.001	49.2	897.4	1.16	2
BE99	0.001	49.2	897.4	1.16	2
BN2	0.001	49.2	897.4	1.16	2
C12	0.0207	3.4	21	4	2
C130	0.0769	17.61	43.6	3.52	4
C141	0.1066	91.96	88.5	1.77	4
C152	0.001	29	644.4	1.58	1
C172	0.001	29	644.4	1.58	1
C177	0.001	29	644.4	1.58	1
C182	0.001	29	644.4	1.58	1
C206	0.001	29	644.4	1.58	1
C208	0.0217	22	66	2.9	1
C21	0.024	20.04	58.6	2.82	2
C210	0.001	29	644.4	1.58	1
C23	0.024	20.04	58.6	2.82	2
C310	0.001	49.2	897.4	1.16	2
C340	0.001	49.2	897.4	1.16	2
C401	0.001	49.2	897.4	1.16	2
C402	0.001	49.2	897.4	1.16	2
C414	0.001	49.2	897.4	1.16	2
C421	0.001	49.2	897.4	1.16	2
C425	0.001	49.2	897.4	1.16	2
C441	0.001	49.2	897.4	1.16	2
C5	0.237	12	53	3	4
C500	0.0643	18	155	0.9	2
C501	0.0643	18	155	0.9	2
C550	0.0496	3.95	42.6	3.82	2
C560	0.0496	3.95	42.6	3.82	2
C650	0.0496	3.95	42.6	3.82	2
C9	0.1291	3.8	14.3	3.15	2

Environmental Benefit

Surface :		Emissions Coefficients (lb/1000lb Fuel)			# of Engines
		HC	CO	NOx	
Known Aircraft	Fuel (lb/min/engine)				
CA21	0.0217	22	66	2.9	2
CL44	0.015	4	35.4	2.2	4
CL60	0.0496	3.95	42.6	3.82	2
CL61	0.0496	3.95	42.6	3.82	2
CONC	0.421	33.4	100.1	1.7	4
CRJ	0.0496	3.95	42.6	3.82	2
CV58	0.0217	22	66	2.9	2
D28	0.0217	22	66	2.9	2
D328	0.04	0	14.9	5.7	2
DA01	0.1291	3.8	14.3	3.15	2
DA02	0.0496	3.95	42.6	3.82	2
DA05	0.0496	3.95	42.6	3.82	3
DA10	0.024	20.04	58.6	2.82	2
DA20	0.0496	3.95	42.6	3.82	3
DC10-30	0.215	21.8	61.8	3.6	3
DC3	0.0217	22	66	2.9	2
DC6	0.0769	17.61	43.6	3.52	4
DC86	0.1291	3.8	14.3	3.15	4
DC9-50	0.1474	1.25	10.5	3.2	2
DH2	0.001	49.2	897.4	1.16	1
DH3	0.04	0	14.9	5.7	1
DH6	0.0207	3.4	21	4	2
DH8	0.04	0	14.9	5.7	2
E110	0.0207	3.4	21	4	2
E120	0.04	0	16.3	5.5	2
E2	0.05	0	9.2	6.9	2
EA6	0.024	20.04	58.6	2.82	2
F14	0.1259	38.44	68.2	2.4	2
F15	0.1336	2.26	19.3	3.96	2
F16	0.1336	2.26	19.3	3.96	2
F18	0.1336	2.26	19.3	3.96	2
FA27	0.0496	3.95	42.6	3.82	2
FA28	0.115	92.74	88.23	1.83	2
FFJ	0.0643	18	155	0.9	2
FK10	0.11	3.4	24.1	2.5	2
FK70	0.11	3.4	24.1	2.5	2
G159	0.05	0	9.2	6.9	2
G2	0.0496	3.95	42.6	3.82	2
G3	0.0496	3.95	42.6	3.82	2
G4	0.0496	3.95	42.6	3.82	2

Environmental Benefit

Surface :		Emissions Coefficients (lb/1000lb Fuel)			
		Fuel (lb/min/engine)	HC	CO	
G73	0.04	0	14.9	5.7	2
HS25	0.0496	3.95	42.6	3.82	2
IL96	0.208	1.92	21.86	4.8	4
KC35	0.237	12	53	3	4
KE35	0.237	12	53	3	4
KR35	0.237	12	53	3	4
L1011	0.225	67.75	88.99	2.86	3
L188	0.0769	17.61	43.6	3.52	4
L1F	0.225	67.75	88.99	2.86	3
L329	0.1066	91.96	88.5	1.77	4
L382	0.0769	17.61	43.6	3.52	4
LR24	0.0643	18	155	0.9	2
LR25	0.064	18	155	0.9	2
LR31	0.024	20.04	58.6	2.82	2
LR35	0.024	20.04	58.6	2.82	2
LR55	0.024	20.04	58.6	2.82	2
LR60	0.024	20.04	58.6	2.82	2
M1F	0.213	1.66	20.32	4.9	3
MD11	0.205	1.38	18.02	4.85	3
MD88	0.1372	3.33	12.3	3.7	2
MO20	0.001	49.2	897.4	1.16	1
MU2	0.0217	22	66	2.9	2
MU3	0.064	18	155	0.9	2
MU30	0.064	18	155	0.9	2
N22B	0.0217	22	66	2.9	2
N265	0.1291	3.8	14.3	3.15	2
NEWX	0.208	1.92	21.86	4.8	4
P3	0.0769	17.61	43.6	3.52	4
PA23	0.001	29	644.4	1.58	2
PA24	0.001	29	644.4	1.58	1
PA28	0.001	29	644.4	1.58	1
PA30	0.001	49.2	897.4	1.16	2
PA31	0.0207	3.4	21	4	2
PA32	0.001	49.2	897.4	1.16	1
PA34	0.001	49.2	897.4	1.16	2
PA41	0.0207	3.4	21	4	2
PA42	0.0207	3.4	21	4	2
PA46	0.001	49.2	897.4	1.16	1
PA60	0.001	49.2	897.4	1.16	2
PARO	0.001	29	644.4	1.58	1

Environmental Benefit

Surface :		Emissions Coefficients (lb/1000lb Fuel)				
		Fuel (lb/min/engine)	HC	CO	NOx	
PASE	0.001	49.2	897.4	1.16	2	
PAYE	0.0207	3.4	21	4	2	
PAZT	0.001	49.2	897.4	1.16	2	
S20	0.0217	22	66	2.9	2	
SF34	0.015	4	35.4	2.2	2	
SH7	0.04	0	14.9	5.7	2	
SHD3	0.0769	17.61	43.6	3.52	2	
SW3	0.0141	79.11	61.5	2.86	2	
SW4	0.0141	79.11	61.5	2.86	2	
T1	0.064	18	155	0.9	2	
T2	0.024	20.04	58.6	2.82	2	
T34	0.001	49.2	897.4	1.16	1	
T37	0.064	18	155	0.9	2	
T38I	0.024	20.04	58.6	2.82	2	
TA4	0.024	20.04	58.6	2.82	1	
TU34	0.0496	3.95	42.6	3.82	2	
TU5	0.0496	3.95	42.6	3.82	2	
U21	0.0217	22	66	2.9	2	
UH1	0.0179	63.38	29.6	1.41	1	
UH60	0.0179	63.38	29.6	1.41	1	
WW24	0.024	20.04	58.6	2.82	2	
YK4	0	5.4	20.7	5.5	2	
YS11	0.0496	3.95	42.6	3.82	2	

Environmental Benefit

Table B-5: Take-Off

ICAO Fuel and emissions coefficients by aircraft type.

Take-Off		Emissions Coefficients (lb/1000lb Fuel)			
		HC	CO	NOx	# of Engines
Known Aircraft	Fuel (lb/min/engine)				
A10	0.205	0.114	1.39	15.25	2
A300	2.58	0.04	0.06	28.57	2
A310	2.254	0.3	1	29.6	2
A320	1.051	0.23	0.9	24.6	2
A4	0.205	0.114	1.39	15.25	1
A6	0.205	0.114	1.39	15.25	2
AA5	0.013	10	199	1.99	1
AC50	0.013	10	199	1.99	2
AC69	0.08	0	4.7	7	2
AJ25	0.205	0.114	1.39	15.25	2
AN12	0.2994	0.28	2	8.88	4
ARJ	0.407	0.06	0	11.61	2
AT42	0.13	0	2	13.8	2
B1	1.174	4	1.5	12.1	4
B52	1.174	4	1.5	12.1	8
B707	1.174	4	1.5	12.1	4
B727-200	1.178	0.241	0.03	19.4	3
B73S	0.946	0.04	0.9	17.7	2
B747-200	2.4419	0.2	0.2	31.6	4
B74F	2.342	0.06	0.44	28.1	4
B74R	2.342	0.06	0.44	28.1	4
B757-200	1.86	0.04	1.01	52.7	2
B767-200	2.145	0.29	1	29.8	2
B777	3.411	0.1	0.1	45	2
BA11	0.889	0.98	1.81	23.27	2
BA14	0.889	0.98	1.81	23.27	2
BA31	0.08	0	4.7	7	2
BA41	0.08	0	4.7	7	2
BA46	0.3581	0.06	0.3	13.53	4
BATP	0.08	0	4.7	7	2
BE02	0.08	0	4.7	7	2
BE10	0.013	10	199	1.99	2
BE18	0.0057	20.81	974.1	4.87	1
BE20	0.013	10	199	1.99	2
BE30	0.08	0	4.7	7	2
BE33	0.013	10	199	1.99	1
BE35	0.0057	20.81	974.1	4.87	1

Environmental Benefit

Take-Off	Fuel (lb/min/engine)	Emissions Coefficients (lb/1000lb Fuel)			
		HC	CO	NOx	# of Engines
BE36	0.013	10	199	1.99	1
BE3B	0.08	0	4.7	7	2
BE40	0.35	0.1	27	4.2	2
BE55	0.013	10	199	1.99	2
BE58	0.013	10	199	1.99	2
BE60	0.013	10	199	1.99	2
BE76	0.013	10	199	1.99	2
BE8T	0.013	10	199	1.99	2
BE90	0.013	10	199	1.99	2
BE99	0.013	10	199	1.99	2
BN2	0.013	10	199	1.99	2
C12	0.08	0	0.71	9.7	2
C130	0.2994	0.28	2	8.88	4
C141	1.2573	0.3	1.3	11	4
C152	0.0057	20.81	974.1	4.87	1
C172	0.0057	20.81	974.1	4.87	1
C177	0.0057	20.81	974.1	4.87	1
C182	0.0057	20.81	974.1	4.87	1
C206	0.0057	20.81	974.1	4.87	1
C208	0.08	0	4.7	7	1
C21	0.205	0.114	1.39	15.25	2
C210	0.0057	20.81	974.1	4.87	1
C23	0.205	0.114	1.39	15.25	2
C310	0.013	10	199	1.99	2
C340	0.013	10	199	1.99	2
C401	0.013	10	199	1.99	2
C402	0.013	10	199	1.99	2
C414	0.013	10	199	1.99	2
C421	0.013	10	199	1.99	2
C425	0.013	10	199	1.99	2
C441	0.013	10	199	1.99	2
C5	2.4419	0.2	0.2	31.6	4
C500	0.3503	0.1	27	4.2	2
C501	0.3503	0.1	27	4.2	2
C550	0.407	0.06	0	11.61	2
C560	0.407	0.06	0	11.61	2
C650	0.407	0.06	0	11.61	2
C9	0.9892	0.25	0.9	17.2	2
CA21	0.08	0	4.7	7	2
CL44	0.101	1	2.5	13.8	4

Environmental Benefit

Take-Off	Fuel (lb/min/engine)	Emissions Coefficients (lb/1000lb Fuel)			
		HC	CO	NOx	# of Engines
CL60	0.407	0.06	0	11.61	2
CL61	0.407	0.06	0	11.61	2
CONC	6.365	2.9	29	9.5	4
CRJ	0.407	0.06	0	11.61	2
CV58	0.08	0	4.7	7	2
D28	0.08	0	4.7	7	2
D328	0.13	0	2	13.8	2
DA01	0.9892	0.25	0.9	17.2	2
DA02	0.407	0.06	0	11.61	2
DA05	0.407	0.06	0	11.61	3
DA10	0.205	0.114	1.39	15.25	2
DA20	0.407	0.06	0	11.61	3
DC10-30	2.487	0.6	0.5	36.3	3
DC3	0.08	0	4.7	7	2
DC6	0.2994	0.28	2	8.88	4
DC86	0.9892	0.25	0.9	17.2	4
DC9-50	1.245	0.22	0.9	20.6	2
DH2	0.013	10	199	1.99	1
DH3	0.13	0	2	13.8	1
DH6	0.08	0	0.71	9.7	2
DH8	0.13	0	2	13.8	2
E110	0.08	0	0.71	9.7	2
E120	0.12	0	2.2	12.7	2
E2	0.15	0	2.1	18.1	2
EA6	0.205	0.114	1.39	15.25	2
F14	5.0399	1	15	6.75	2
F15	5.5691	0.1	55.1	16.5	2
F16	5.5691	0.1	55.1	16.5	2
F18	5.5691	0.1	55.1	16.5	2
FA27	0.407	0.06	0	11.61	2
FA28	0.7203	0.88	0.44	18.92	2
FFJ	0.3503	0.1	27	4.2	2
FK10	0.76	0.8	0.7	21.1	2
FK70	0.76	0.8	0.7	21.1	2
G159	0.15	0	2.1	18.1	2
G2	0.407	0.06	0	11.61	2
G3	0.407	0.06	0	11.61	2
G4	0.407	0.06	0	11.61	2
G73	0.13	0	2	13.8	2
HS25	0.407	0.06	0	11.61	2

Environmental Benefit

Take-Off		Emissions Coefficients (lb/1000lb Fuel)			
Known Aircraft	Fuel (lb/min/engine)	HC	CO	NOx	# of Engines
IL96	2.342	0.06	0.44	28.1	4
KC35	2.4419	0.2	0.2	31.6	4
KE35	2.4419	0.2	0.2	31.6	4
KR35	2.4419	0.2	0.2	31.6	4
L1011	1.877	0.15	0.78	37.33	3
L188	0.2994	0.28	2	8.88	4
L1F	1.877	0.15	0.78	37.33	3
L329	1.2573	0.3	1.3	11	4
L382	0.2994	0.28	2	8.88	4
LR24	0.3503	0.1	27	4.2	2
LR25	0.35	0.1	27	4.2	2
LR31	0.205	0.114	1.39	15.25	2
LR35	0.205	0.114	1.39	15.25	2
LR55	0.205	0.114	1.39	15.25	2
LR60	0.205	0.114	1.39	15.25	2
M1F	2.647	0.1	0.37	32.8	3
MD11	2.629	0.04	0.05	28.12	3
MD88	1.32	0.28	0.8	25.7	2
MO20	0.013	10	199	1.99	1
MU2	0.08	0	4.7	7	2
MU3	0.35	0.1	27	4.2	2
MU30	0.35	0.1	27	4.2	2
N22B	0.08	0	4.7	7	2
N265	0.9892	0.25	0.9	17.2	2
NEWX	2.342	0.06	0.44	28.1	4
P3	0.2994	0.28	2	8.88	4
PA23	0.0057	20.81	974.1	4.87	2
PA24	0.0057	20.81	974.1	4.87	1
PA28	0.0057	20.81	974.1	4.87	1
PA30	0.013	10	199	1.99	2
PA31	0.08	0	0.71	9.7	2
PA32	0.013	10	199	1.99	1
PA34	0.013	10	199	1.99	2
PA41	0.08	0	0.71	9.7	2
PA42	0.08	0	0.71	9.7	2
PA46	0.013	10	199	1.99	1
PA60	0.013	10	199	1.99	2
PARO	0.0057	20.81	974.1	4.87	1
PASE	0.013	10	199	1.99	2
PAYE	0.08	0	0.71	9.7	2

Environmental Benefit

Take-Off	Fuel (lb/min/engine)	Emissions Coefficients (lb/1000lb Fuel)			
		HC	CO	NOx	# of Engines
PAZT	0.013	10	199	1.99	2
S20	0.08	0	4.7	7	2
SF34	0.101	1	2.5	13.8	2
SH7	0.13	0	2	13.8	2
SHD3	0.2994	0.28	2	8.88	2
SW3	0.0577	0.11	0.8	12.36	2
SW4	0.0577	0.11	0.8	12.36	2
T1	0.35	0.1	27	4.2	2
T2	0.205	0.114	1.39	15.25	2
T34	0.013	10	199	1.99	1
T37	0.35	0.1	27	4.2	2
T38I	0.205	0.114	1.39	15.25	2
TA4	0.205	0.114	1.39	15.25	1
TU34	0.407	0.06	0	11.61	2
TU5	0.407	0.06	0	11.61	2
U21	0.08	0	4.7	7	2
UH1	0.0856	0.29	3	7.36	1
UH60	0.0856	0.29	3	7.36	1
WW24	0.205	0.114	1.39	15.25	2
YK4	0.634	0	0.5	26	2
YS11	0.407	0.06	0	11.61	2

Environmental Benefit

Table B-6: Initial Climb
ICAO Fuel and emissions coefficients by aircraft type.

Climb		Emissions Coefficients (lb/1000lb Fuel)			
		HC	CO	NOx	# of Engines
Known Aircraft	Fuel (lb/min/engine)				
A10	0.173	0.128	2.03	13.08	2
A300	2.096	0.05	0.04	21.69	2
A310	1.885	0.37	1.1	26.6	2
A320	0.862	0.23	0.9	19.6	2
A4	0.173	0.128	2.03	13.08	1
A6	0.173	0.128	2.03	13.08	2
AA5	0.009	8.16	983.3	4.59	1
AC50	0.009	8.16	983.3	4.59	2
AC69	0.0702	0	6.4	6.6	2
AJ25	0.173	0.128	2.03	13.08	2
AN12	0.2769	0.89	2.1	9.22	4
ARJ	0.3343	0.06	0	10.14	2
AT42	0.11	0	2.3	12.3	2
B1	0.932	2	2.8	9.9	4
B52	0.932	2	2.8	9.9	8
B707	0.932	2	2.8	9.9	4
B727-200	0.945	0.28	1.15	15.1	3
B73S	0.792	0.05	0.95	15.5	2
B747-200	1.9996	0.2	0.2	25.6	4
B74F	1.93	0.01	0.57	22.9	4
B74R	1.93	0.01	0.57	22.9	4
B757-200	1.51	0.01	1.23	36.2	2
B767-200	1.795	0.29	1.1	25.6	2
B777	2.689	0.1	0.1	35.5	2
BA11	0.726	1.32	2.06	19.18	2
BA14	0.726	1.32	2.06	19.18	2
BA31	0.0702	0	6.4	6.6	2
BA41	0.0702	0	6.4	6.6	2
BA46	0.2955	0.053	0.25	10.56	4
BATP	0.0702	0	6.4	6.6	2
BE02	0.0702	0	6.4	6.6	2
BE10	0.009	8.16	983.3	4.59	2
BE18	0.0057	20.81	974.1	4.87	1
BE20	0.009	8.16	983.3	4.59	2
BE30	0.0702	0	6.4	6.6	2
BE33	0.009	8.16	983.3	4.59	1
BE35	0.0057	20.81	974.1	4.87	1

Environmental Benefit

Climb		Emissions Coefficients (lb/1000lb Fuel)			
		HC	CO	NOx	# of Engines
Known Aircraft	Fuel (lb/min/engine)				
BE36	0.009	8.16	983.3	4.59	1
BE3B	0.0702	0	6.4	6.6	2
BE40	0.288	0.2	28	3.5	2
BE55	0.009	8.16	983.3	4.59	2
BE58	0.009	8.16	983.3	4.59	2
BE60	0.009	8.16	983.3	4.59	2
BE76	0.009	8.16	983.3	4.59	2
BE8T	0.009	8.16	983.3	4.59	2
BE90	0.009	8.16	983.3	4.59	2
BE99	0.009	8.16	983.3	4.59	2
BN2	0.009	8.16	983.3	4.59	2
C12	0.07	0	0.94	9	2
C130	0.2769	0.89	2.1	9.22	4
C141	0.9227	0.4	1.8	9	4
C152	0.0057	20.81	974.1	4.87	1
C172	0.0057	20.81	974.1	4.87	1
C177	0.0057	20.81	974.1	4.87	1
C182	0.0057	20.81	974.1	4.87	1
C206	0.0057	20.81	974.1	4.87	1
C208	0.0702	0	6.4	6.6	1
C21	0.173	0.128	2.03	13.08	2
C210	0.0057	20.81	974.1	4.87	1
C23	0.173	0.128	2.03	13.08	2
C310	0.009	8.16	983.3	4.59	2
C340	0.009	8.16	983.3	4.59	2
C401	0.009	8.16	983.3	4.59	2
C402	0.009	8.16	983.3	4.59	2
C414	0.009	8.16	983.3	4.59	2
C421	0.009	8.16	983.3	4.59	2
C425	0.009	8.16	983.3	4.59	2
C441	0.009	8.16	983.3	4.59	2
C5	1.9996	0.2	0.2	25.6	4
C500	0.3062	0.2	27	3.7	2
C501	0.3062	0.2	27	3.7	2
C550	0.3343	0.06	0	10.14	2
C560	0.3343	0.06	0	10.14	2
C650	0.3343	0.06	0	10.14	2
C9	0.8113	0.25	1.1	14	2
CA21	0.0702	0	6.4	6.6	2
CL44	0.094	1	2.7	13.2	4

Environmental Benefit

Climb		Emissions Coefficients (lb/1000lb Fuel)			
		HC	CO	NOx	# of Engines
Known Aircraft	Fuel (lb/min/engine)				
CL60	0.3343	0.06	0	10.14	2
CL61	0.3343	0.06	0	10.14	2
CONC	2.329	1.7	19.9	9.3	4
CRJ	0.3343	0.06	0	10.14	2
CV58	0.0702	0	6.4	6.6	2
D28	0.0702	0	6.4	6.6	2
D328	0.11	0	2.3	12.3	2
DA01	0.8113	0.25	1.1	14	2
DA02	0.3343	0.06	0	10.14	2
DA05	0.3343	0.06	0	10.14	3
DA10	0.173	0.128	2.03	13.08	2
DA20	0.3343	0.06	0	10.14	3
DC10-30	1.975	0.7	0.5	29.7	3
DC3	0.0702	0	6.4	6.6	2
DC6	0.2769	0.89	2.1	9.22	4
DC86	0.8113	0.25	1.1	14	4
DC9-50	0.997	0.27	1.1	15.7	2
DH2	0.009	8.16	983.3	4.59	1
DH3	0.11	0	2.3	12.3	1
DH6	0.07	0	0.94	9	2
DH8	0.11	0	2.3	12.3	2
E110	0.07	0	0.94	9	2
E120	0.11	0	2.4	12	2
E2	0.14	0	2.1	16.3	2
EA6	0.173	0.128	2.03	13.08	2
F14	0.9316	0.09	2.1	16.66	2
F15	1.3104	0.05	1.8	44	2
F16	1.3104	0.05	1.8	44	2
F18	1.3104	0.05	1.8	44	2
FA27	0.3343	0.06	0	10.14	2
FA28	0.589	0.16	0	14.64	2
FFJ	0.3062	0.2	27	3.7	2
FK10	0.63	0.3	0.8	16.8	2
FK70	0.63	0.3	0.8	16.8	2
G159	0.14	0	2.1	16.3	2
G2	0.3343	0.06	0	10.14	2
G3	0.3343	0.06	0	10.14	2
G4	0.3343	0.06	0	10.14	2
G73	0.11	0	2.3	12.3	2
HS25	0.3343	0.06	0	10.14	2

Environmental Benefit

Climb	Fuel (lb/min/engine)	Emissions Coefficients (lb/1000lb Fuel)			
		HC	CO	NOx	# of Engines
IL96	1.93	0.01	0.57	22.9	4
KC35	1.9996	0.2	0.2	25.6	4
KE35	1.9996	0.2	0.2	25.6	4
KR35	1.9996	0.2	0.2	25.6	4
L1011	1.546	0.25	1.68	26.89	3
L188	0.2769	0.89	2.1	9.22	4
L1F	1.546	0.25	1.68	26.89	3
L329	0.9227	0.4	1.8	9	4
L382	0.2769	0.89	2.1	9.22	4
LR24	0.3062	0.2	27	3.7	2
LR25	0.288	0.2	28	3.5	2
LR31	0.173	0.128	2.03	13.08	2
LR35	0.173	0.128	2.03	13.08	2
LR55	0.173	0.128	2.03	13.08	2
LR60	0.173	0.128	2.03	13.08	2
M1F	2.085	0.03	0.51	24.7	3
MD11	2.126	0.05	0.04	21.3	3
MD88	1.078	0.43	1.2	20.6	2
MO20	0.009	8.16	983.3	4.59	1
MU2	0.0702	0	6.4	6.6	2
MU3	0.288	0.2	28	3.5	2
MU30	0.288	0.2	28	3.5	2
N22B	0.0702	0	6.4	6.6	2
N265	0.8113	0.25	1.1	14	2
NEWX	1.93	0.01	0.57	22.9	4
P3	0.2769	0.89	2.1	9.22	4
PA23	0.0057	20.81	974.1	4.87	2
PA24	0.0057	20.81	974.1	4.87	1
PA28	0.0057	20.81	974.1	4.87	1
PA30	0.009	8.16	983.3	4.59	2
PA31	0.07	0	0.94	9	2
PA32	0.009	8.16	983.3	4.59	1
PA34	0.009	8.16	983.3	4.59	2
PA41	0.07	0	0.94	9	2
PA42	0.07	0	0.94	9	2
PA46	0.009	8.16	983.3	4.59	1
PA60	0.009	8.16	983.3	4.59	2
PARO	0.0057	20.81	974.1	4.87	1
PASE	0.009	8.16	983.3	4.59	2
PAYE	0.07	0	0.94	9	2

Environmental Benefit

Climb		Emissions Coefficients (lb/1000lb Fuel)			
		Fuel (lb/min/engine)	HC	CO	NOx
PAZT	0.009	8.16	983.3	4.59	2
S20	0.0702	0	6.4	6.6	2
SF34	0.094	1	2.7	13.2	2
SH7	0.11	0	2.3	12.3	2
SHD3	0.2769	0.89	2.1	9.22	2
SW3	0.0515	0.15	1	11.86	2
SW4	0.0515	0.15	1	11.86	2
T1	0.288	0.2	28	3.5	2
T2	0.173	0.128	2.03	13.08	2
T34	0.009	8.16	983.3	4.59	1
T37	0.288	0.2	28	3.5	2
T38I	0.173	0.128	2.03	13.08	2
TA4	0.173	0.128	2.03	13.08	1
TU34	0.3343	0.06	0	10.14	2
TU5	0.3343	0.06	0	10.14	2
U21	0.0702	0	6.4	6.6	2
UH1	0.0856	0.29	3	7.36	1
UH60	0.0856	0.29	3	7.36	1
WW24	0.173	0.128	2.03	13.08	2
YK4	0.533	0	0.4	22	2
YS11	0.3343	0.06	0	10.14	2

Environmental Benefit

Table B-7: Approach

ICAO Fuel and emissions coefficients by aircraft type.

Approach	Fuel (lb/min/engine)	Emissions Coefficients (lb/1000lb Fuel)			
		HC	CO	NOx	# of Engines
A10	0.067	4.26	22.38	5.9	2
A300	0.672	0.11	1.91	12.53	2
A310	0.641	0.45	2.8	10.8	2
A320	0.291	0.4	2.5	8	2
A4	0.067	4.26	22.38	5.9	1
A6	0.067	4.26	22.38	5.9	2
AA5	0.0046	9.7	691.3	10.1	1
AC50	0.0046	9.7	691.3	10.1	2
AC69	0.0407	3.8	21.8	4.5	2
AJ25	0.067	4.26	22.38	5.9	2
AN12	0.1436	1.96	5.1	7.49	4
ARJ	0.119	0.13	1.9	6.86	2
AT42	0.07	0	6	8.1	2
B1	0.346	4	24.5	4.8	4
B52	0.346	4	24.5	4.8	8
B707	0.346	4	24.5	4.8	4
B727-200	0.3402	0.55	2.77	6.9	3
B73S	0.29	0.08	3.8	8.3	2
B747-200	0.6804	0.3	1.7	7.8	4
B74F	0.658	0.13	2	11.6	4
B74R	0.658	0.13	2	11.6	4
B757-200	0.57	0.04	1.71	7.5	2
B767-200	0.615	0.47	3.1	10.3	2
B777	0.875	0.2	0.4	12	2
BA11	0.279	7.23	20.3	7.94	2
BA14	0.279	7.23	20.3	7.94	2
BA31	0.0407	3.8	21.8	4.5	2
BA41	0.0407	3.8	21.8	4.5	2
BA46	0.1034	0.217	7.1	6.6	4
BATP	0.0407	3.8	21.8	4.5	2
BE02	0.0407	3.8	21.8	4.5	2
BE10	0.0046	9.7	691.3	10.1	2
BE18	0.0032	0.03322	1187.8	1.14	1
BE20	0.0046	9.7	691.3	10.1	2
BE30	0.0407	3.8	21.8	4.5	2
BE33	0.0046	9.7	691.3	10.1	1
BE35	0.0032	0.03322	1187.8	1.14	1

Environmental Benefit

Approach	Fuel (lb/min/engine)	Emissions Coefficients (lb/1000lb Fuel)			
		HC	CO	NOx	# of Engines
BE36	0.0046	9.7	691.3	10.1	1
BE3B	0.0407	3.8	21.8	4.5	2
BE40	0.129	0.0027	88	1.5	2
BE55	0.0046	9.7	691.3	10.1	2
BE58	0.0046	9.7	691.3	10.1	2
BE60	0.0046	9.7	691.3	10.1	2
BE76	0.0046	9.7	691.3	10.1	2
BE8T	0.0046	9.7	691.3	10.1	2
BE90	0.0046	9.7	691.3	10.1	2
BE99	0.0046	9.7	691.3	10.1	2
BN2	0.0046	9.7	691.3	10.1	2
C12	0.0397	0	4.8	6.2	2
C130	0.1436	1.96	5.1	7.49	4
C141	0.4784	3.79	9	7.3	4
C152	0.0032	0.03322	1187.8	1.14	1
C172	0.0032	0.03322	1187.8	1.14	1
C177	0.0032	0.03322	1187.8	1.14	1
C182	0.0032	0.03322	1187.8	1.14	1
C206	0.0032	0.03322	1187.8	1.14	1
C208	0.0407	3.8	21.8	4.5	1
C21	0.067	4.26	22.38	5.9	2
C210	0.0032	0.03322	1187.8	1.14	1
C23	0.067	4.26	22.38	5.9	2
C310	0.0046	9.7	691.3	10.1	2
C340	0.0046	9.7	691.3	10.1	2
C401	0.0046	9.7	691.3	10.1	2
C402	0.0046	9.7	691.3	10.1	2
C414	0.0046	9.7	691.3	10.1	2
C421	0.0046	9.7	691.3	10.1	2
C425	0.0046	9.7	691.3	10.1	2
C441	0.0046	9.7	691.3	10.1	2
C5	0.6804	0.3	1.7	7.8	4
C500	0.1239	2.7	88	1.5	2
C501	0.1239	2.7	88	1.5	2
C550	0.119	0.13	1.9	6.86	2
C560	0.119	0.13	1.9	6.86	2
C650	0.119	0.13	1.9	6.86	2
C9	0.2861	0.4	2.2	6.3	2
CA21	0.0407	3.8	21.8	4.5	2
CL44	0.045	1.5	5.3	6.9	4

Environmental Benefit

Approach	Fuel (lb/min/engine)	Emissions Coefficients (lb/1000lb Fuel)			
		HC	CO	NOx	# of Engines
CL60	0.119	0.13	1.9	6.86	2
CL61	0.119	0.13	1.9	6.86	2
CONC	1.171	11.4	52.9	3.5	4
CRJ	0.119	0.13	1.9	6.86	2
CV58	0.0407	3.8	21.8	4.5	2
D28	0.0407	3.8	21.8	4.5	2
D328	0.07	0	6	8.1	2
DA01	0.2861	0.4	2.2	6.3	2
DA02	0.119	0.13	1.9	6.86	2
DA05	0.119	0.13	1.9	6.86	3
DA10	0.067	4.26	22.38	5.9	2
DA20	0.119	0.13	1.9	6.86	3
DC10-30	0.66	1	4.3	9.5	3
DC3	0.0407	3.8	21.8	4.5	2
DC6	0.1436	1.96	5.1	7.49	4
DC86	0.2861	0.4	2.2	6.3	4
DC9-50	0.354	1.96	2.7	8	2
DH2	0.0046	9.7	691.3	10.1	1
DH3	0.07	0	6	8.1	1
DH6	0.0397	0	4.8	6.2	2
DH8	0.07	0	6	8.1	2
E110	0.0397	0	4.8	6.2	2
E120	0.06	0	6.5	7.9	2
E2	0.08	0	3.5	10	2
EA6	0.067	4.26	22.38	5.9	2
F14	0.3273	1.12	15.2	7.08	2
F15	0.378	0.6	3	11	2
F16	0.378	0.6	3	11	2
F18	0.378	0.6	3	11	2
FA27	0.119	0.13	1.9	6.86	2
FA28	0.222	6.97	22.22	5.92	2
FFJ	0.1239	2.7	88	1.5	2
FK10	0.23	0.9	3.9	5.7	2
FK70	0.23	0.9	3.9	5.7	2
G159	0.08	0	3.5	10	2
G2	0.119	0.13	1.9	6.86	2
G3	0.119	0.13	1.9	6.86	2
G4	0.119	0.13	1.9	6.86	2
G73	0.07	0	6	8.1	2
HS25	0.119	0.13	1.9	6.86	2

Environmental Benefit

Approach	Fuel (lb/min/engine)	Emissions Coefficients (lb/1000lb Fuel)			
		HC	CO	NOx	# of Engines
IL96	0.658	0.13	2	11.6	4
KC35	0.6804	0.3	1.7	7.8	4
KE35	0.6804	0.3	1.7	7.8	4
KR35	0.6804	0.3	1.7	7.8	4
L1011	0.566	5.96	20.65	8.18	3
L188	0.1436	1.96	5.1	7.49	4
L1F	0.566	5.96	20.65	8.18	3
L329	0.4784	3.79	9	7.3	4
L382	0.1436	1.96	5.1	7.49	4
LR24	0.1239	2.7	88	1.5	2
LR25	0.129	0.0027	88	1.5	2
LR31	0.067	4.26	22.38	5.9	2
LR35	0.067	4.26	22.38	5.9	2
LR55	0.067	4.26	22.38	5.9	2
LR60	0.067	4.26	22.38	5.9	2
M1F	0.703	0.14	1.78	12	3
MD11	0.688	0.11	1.9	12.66	3
MD88	0.3833	1.6	4.2	9.1	2
MO20	0.0046	9.7	691.3	10.1	1
MU2	0.0407	3.8	21.8	4.5	2
MU3	0.129	0.0027	88	1.5	2
MU30	0.129	0.0027	88	1.5	2
N22B	0.0407	3.8	21.8	4.5	2
N265	0.2861	0.4	2.2	6.3	2
NEWX	0.658	0.13	2	11.6	4
P3	0.1436	1.96	5.1	7.49	4
PA23	0.0032	0.03322	1187.8	1.14	2
PA24	0.0032	0.03322	1187.8	1.14	1
PA28	0.0032	0.03322	1187.8	1.14	1
PA30	0.0046	9.7	691.3	10.1	2
PA31	0.0397	0	4.8	6.2	2
PA32	0.0046	9.7	691.3	10.1	1
PA34	0.0046	9.7	691.3	10.1	2
PA41	0.0397	0	4.8	6.2	2
PA42	0.0397	0	4.8	6.2	2
PA46	0.0046	9.7	691.3	10.1	1
PA60	0.0046	9.7	691.3	10.1	2
PARO	0.0032	0.03322	1187.8	1.14	1
PASE	0.0046	9.7	691.3	10.1	2
PAYE	0.0397	0	4.8	6.2	2

Environmental Benefit

Approach	Fuel (lb/min/engine)	Emissions Coefficients (lb/1000lb Fuel)			
		HC	CO	NOx	# of Engines
PAZT	0.0046	9.7	691.3	10.1	2
S20	0.0407	3.8	21.8	4.5	2
SF34	0.045	1.5	5.3	6.9	2
SH7	0.07	0	6	8.1	2
SHD3	0.1436	1.96	5.1	7.49	2
SW3	0.0315	0.64	7	9.92	2
SW4	0.0315	0.64	7	9.92	2
T1	0.129	0.0027	88	1.5	2
T2	0.067	4.26	22.38	5.9	2
T34	0.0046	9.7	691.3	10.1	1
T37	0.129	0.0027	88	1.5	2
T38I	0.067	4.26	22.38	5.9	2
TA4	0.067	4.26	22.38	5.9	1
TU34	0.119	0.13	1.9	6.86	2
TU5	0.119	0.13	1.9	6.86	2
U21	0.0407	3.8	21.8	4.5	2
UH1	0.0856	0.29	3	7.36	1
UH60	0.0856	0.29	3	7.36	1
WW24	0.067	4.26	22.38	5.9	2
YK4	0.211	0	2.7	9	2
YS11	0.119	0.13	1.9	6.86	2

Environmental Benefit

Table B-8: Fuel coefficient for cruise above 3000'

Median High and low obtained from Simulation [2].

AC TYPE	Average (lb/min)	Median (lb/min)	Low Rank (lb/min)	High Rank (lb/min)
A10	32.2327	32.053	28.674	36.248
A300	185.398	182.201	173.389	194.721
A310	137.8256	135.031	122.973	157.343
A320	85.8047	81.421	75.828	104.109
A4	15.1039	15.335	13.773	16.356
A6	40.0715	39.639	37.588	43.2
AA5	1.5895	1.588	1.519	1.666
AC50	4.3484	4.332	4.219	4.511
AC69	6.7705	6.79	6.235	7.257
AJ25	15.415	15.407	14.121	16.115
AN12	94.515	94.637	93.07	95.716
ARJ	53.6423	54.703	52.327	54.856
AT42	23.767	23.609	22.902	24.592
B1	322.575	319.665	301.18	341.654
B52	348.2557	350.371	311.427	375.497
B707	174.8232	170.002	160.92	186.91
B727-200	139.5207	134.772	127.635	154.815
B737-200	88.4591	85.651	80.283	95.658
B73F	71.8155	68.639	64.014	80.976
B73S	79.151	76.768	71.298	87.145
B747-100	333.1485	330.136	303.725	362.655
B747-200	324.025	315.027	297.136	361.583
B74F	349.2227	344.482	308.041	399.883
B74R	499.8987	477.652	465.939	580.611
B757-200	124.427	119.91	114.157	131.744
B767-200	143.1394	137.55	126.285	157.488
B777	345.5191	340.842	328.415	364.556
BA11	58.1086	59.384	53.937	61.258
BA14	10.3897	10.288	9.921	10.861
BA31	9.8907	9.937	9.527	10.413
BA41	16.2623	16.075	15.578	16.912
BA46	56.4801	56.537	54.556	57.852
BATP	34.1654	33.899	32.563	35.785
BE02	11.2194	11.139	10.761	11.643
BE10	7.7632	7.768	7.198	8.153
BE18	6.3804	6.343	6.21	6.521
BE20	8.3034	8.317	7.617	8.854
BE30	9.2166	9.299	8.502	9.867
BE33	1.9899	1.972	1.918	2.028
BE35	1.7829	1.779	1.713	1.844

Environmental Benefit

AC TYPE	Average (lb/min)	Median (lb/min)	Low Rank (lb/min)	High Rank (lb/min)
BE36	2.3826	2.372	2.309	2.461
BE3B	9.8842	9.949	9.047	10.615
BE40	10.2569	10.327	9.385	10.961
BE55	3.3456	3.33	3.216	3.478
BE58	3.5537	3.53	3.409	3.688
BE60	4.4778	4.429	4.135	4.712
BE76	2.5611	2.545	2.457	2.636
BE8T	5.6973	5.69	5.481	5.909
BE90	6.1432	6.164	5.716	6.508
BE99	7.1448	7.12	6.701	7.627
BN2	4.6711	4.796	4.214	4.863
C12	10.0911	9.988	9.387	10.701
C130	118.1538	116.022	107.076	126.717
C141	222.1483	222.511	199.161	240.888
C152	1.14	1.127	1.077	1.256
C172	1.4569	1.439	1.391	1.507
C177	1.6556	1.641	1.581	1.739
C182	1.6715	1.659	1.61	1.727
C206	2.5032	2.389	2.303	2.785
C208	4.6858	4.681	4.43	5.005
C21	1.8807	1.907	1.742	1.996
C210	1.9253	1.906	1.838	1.996
C23	16.6624	16.555	16.215	17.22
C310	3.1571	3.139	3.036	3.294
C340	3.9646	3.934	3.782	4.134
C401	4.4726	4.459	4.322	4.587
C402	4.4112	4.382	4.216	4.614
C414	4.4759	4.457	4.227	4.703
C421	4.4466	4.466	4.213	4.674
C425	5.5149	5.549	5.129	5.794
C441	6.4944	6.534	5.868	6.97
C5	542.155	555.335	486.92	604.471
C500	23.9294	6.46	5.26	28.068
C501	7.3496	7.36	6.752	7.792
C550	9.889	9.961	8.95	10.61
C560	10.2712	10.365	9.288	10.977
C650	14.3294	14.443	13.121	15.193
C9	69.7315	70.181	63.903	74.166
CA21	9.0395	9.215	8.523	9.4
CL44	136.4347	142.612	112.161	143.79
CL60	26.4495	26.469	23.849	28.058
CL61	25.8128	25.996	24.282	27.261
CONC	291.477	291.405	291.405	291.621
CRJ	31.3148	31.388	30.546	31.998

Environmental Benefit

AC TYPE	Average (lb/min)	Median (lb/min)	Low Rank (lb/min)	High Rank (lb/min)
CV58	36.6297	36.244	35.164	37.756
D28	8.0929	8.175	7.694	8.427
D328	20.4703	20.308	19.751	21.056
DA01	11.887	11.862	10.898	12.623
DA02	19.5649	19.899	17.905	20.868
DA05	25.9776	26.662	23.304	27.677
DA10	11.5797	11.671	10.544	12.521
DA20	18.7198	18.844	17.514	19.585
DC10-10	221.9781	218.568	209.483	231.662
DC10-30	252.6964	243.55	228.106	281.177
DC3	17.5197	17.424	17.084	17.812
DC6	63.8683	65.07	57.509	66.871
DC86	211.8285	211.521	203.607	219.748
DC8-63	221.3457	216.782	186.788	264.764
DC9-30	84.9191	82.677	77.703	90.194
DC9-50	99.4923	95.628	89.26	108.51
DH2	3.4197	3.403	3.315	3.601
DH3	5.5091	5.649	4.9	6.034
DH6	7.3899	7.35	6.988	7.777
DH8	22.4596	22.234	21.434	23.395
E110	8.15	8.156	7.848	8.642
E120	17.1866	16.964	16.447	17.861
E2	33.1595	33.218	29.224	37.594
EA6	42.0635	42.281	37.037	46.533
F14	46.6428	47.769	41.085	53.001
F15	43.3066	43.239	37.604	48.965
F16	20.6793	20.378	17.203	23.516
F18	40.0041	39.743	33.564	45.574
FA27	26.9504	27.022	26.105	27.497
FA28	42.0422	42.155	41.057	42.865
FFJ	21.5695	21.569	21.559	21.58
FK10	61.5852	61.839	59.774	63.132
FK70	50.8923	51.62	45.992	53.396
G159	23.1674	23.324	21.951	24.031
G2	41.079	40.825	38.112	42.78
G3	43.8701	44.239	39.825	46.707
G4	46.8939	47.079	41.827	50.201
G73	8.3026	8.303	8.284	8.322
HS25	13.4762	13.59	12.343	14.447
IL96	333.5302	333.53	333.53	333.53
KC35	215.0882	213.34	207.267	227.817
KE35	6.3421	6.453	5.894	6.906
KR35	6.6782	6.681	6.176	7.085
L1011	232.7993	225.791	214.564	252.333

Environmental Benefit

AC TYPE	Average (lb/min)	Median (lb/min)	Low Rank (lb/min)	High Rank (lb/min)
L188	76.868	76.354	74.146	79.79
L1F	6.7175	6.886	6.385	7.013
L329	26.5481	26.977	23.163	28.957
L382	110.0453	107.491	99.224	123.717
LR24	7.9296	7.98	7.264	8.545
LR25	9.7835	9.81	8.779	10.523
LR31	9.8023	9.964	8.601	10.726
LR35	11.7465	11.875	10.731	12.618
LR55	13.43	13.452	12.136	14.247
LR60	14.9245	15.429	12.401	16.444
M1F	407.3305	404.901	367.975	442.309
MD11	212.3757	210.824	188.921	239.516
MD88	97.6956	95.579	89.785	103.842
MO20	1.6965	1.692	1.632	1.752
MU2	5.8237	5.854	5.408	6.14
MU3	10.0402	10.023	9.075	11.263
MU30	9.538	9.699	8.813	10.068
N22B	6.8902	6.89	6.89	6.89
N265	15.5186	15.547	14.094	16.545
NEWX	406.5486	383.925	376.107	486.06
P3	95.0722	93.315	87.241	101.843
PA23	2.5542	2.486	2.39	2.614
PA24	1.6682	1.647	1.601	1.746
PA28	1.9812	1.96	1.902	2.037
PA30	2.4165	2.418	2.352	2.489
PA31	4.6651	4.643	4.49	4.82
PA32	2.3354	2.333	2.26	2.414
PA34	2.7492	2.721	2.649	2.841
PA41	6.085	6.105	5.616	6.606
PA42	7.4255	7.508	6.833	7.876
PA46	2.7479	2.75	2.587	2.896
PA60	3.6357	3.634	3.477	3.781
PARO	1.6307	1.631	1.557	1.689
PASE	2.7179	2.72	2.591	2.811
PAYE	6.3138	6.368	5.864	6.691
PAZT	3.3618	3.356	3.256	3.447
S20	6.3373	6.524	5.975	6.531
SF34	18.5033	18.304	17.702	19.16
SH7	8.4278	8.444	8.181	8.648
SHD3	15.4652	15.367	14.702	16.279
SW3	8.481	8.311	7.703	9.222
SW4	6.7337	6.705	6.426	6.993
T1	9.944	10.047	8.85	11.111
T2	17.9705	17.891	16.612	19.602

Environmental Benefit

AC TYPE	Average (lb/min)	Median (lb/min)	Low Rank (lb/min)	High Rank (lb/min)
T34	2.7773	2.727	2.677	2.841
T37	8.9619	8.86	8.378	9.505
T38I	6.6322	6.566	5.01	8.198
TA4	6.0641	6.362	5.065	7.007
TU34	65.7463	65.746	64.777	66.716
TU5	131.0507	130.992	120.581	133.397
U21	6.5825	6.542	6.385	6.891
UH1	6.5948	6.406	6.268	6.807
UH60	6.4028	6.367	6.25	6.64
WW24	15.4429	15.623	14.281	16.235
YK4	6.3381	6.206	6.155	6.548
YS11	34.6873	34.705	34.192	35.26

Table B-9: Emissions coefficients for Cruise, above 3000',Phase of Flight (Baseline scenario)

- No wind optimized Direct Route or optimal climb and descent are considered.
For more details see ref [3].

Cruise Baseline case	Emissions Coefficients (lb/1000lb Fuel)		
AC Type	NOx	CO	HC
A10	10.6906	5.5792	0.4981
A300	18.6146	10.5469	4.4282
A310	14.8003	4.3566	1.0298
A320	13.784	5.6605	0.6399
A4	10.6576	5.5114	0.4939
A6	10.6828	5.5629	0.4978
AA5	10.0591	691.3008	9.6596
AC50	10.0798	691.2988	9.6757
AC69	8.1866	3.9868	0.1858
AJ25	9.5244	3.0795	0.435
AN12	7.4899	5.0994	1.9587
ARJ	6.8598	1.8981	0.1281
AT42	13.0833	4.3018	0
B1	4.8	24.5	4
B52	4.8	24.5	4
B707	12.8721	31.2689	35.437
B727-200	10.3084	3.6936	0.6061
B737-200	10.2545	5.0299	0.7806
B73F	11.3638	11.3024	0.8086
B73S	11.5309	12.3328	1.0151
B747-100	20.3216	13.7517	7.3394
B747-200	16.7521	12.3089	4.5551
B74F	18.1367	2.1556	0.2996
B74R	20.1499	3.1049	0.2999
B757-200	16.233	7.8059	0.6694
B767-200	15.7101	4.938	1.0578
B777	12	0.3998	0.1998
BA11	11.1782	11.6334	1.4818
BA14	11.3848	12.6548	1.5872
BA31	8.1921	3.9928	0.1916
BA41	8.1907	4.0171	0.199
BA46	8.6314	6.7233	0.6757
BATP	8.1994	3.998	0.1975
BE02	8.1914	3.9968	0.1931

Environmental Benefit

Cruise Baseline case	Emissions Coefficients (lb/1000lb Fuel)		
	NOx	CO	HC
AC Type			
BE10	10.0882	691.2998	9.6884
BE18	1.1281	1187.8004	0.0301
BE20	10.0892	691.2998	9.6892
BE30	8.1021	4.4123	0.2748
BE33	10.0641	691.3005	9.6641
BE35	1.0916	1187.8	0.032
BE36	10.066	691.3002	9.6659
BE3B	7.8137	5.8018	0.5559
BE40	9.8547	3.7923	0.4484
BE55	10.0763	691.3002	9.6761
BE58	10.0769	691.2998	9.6765
BE60	10.0796	691.298	9.6791
BE76	10.0683	691.2976	9.6698
BE8T	10.0872	691.3003	9.6869
BE90	10.0849	691.2997	9.685
BE99	10.0905	691.3002	9.6906
BN2	10.084	691.2991	9.6818
C12	8.1889	3.8924	0.1903
C130	7.49	5.1	1.9599
C141	7.3	9	3.79
C152	1.069	1187.8041	0.0278
C172	1.0891	1187.7995	0.0317
C177	1.0969	1187.7996	0.0321
C182	1.1008	1187.7999	0.0316
C206	1.1125	1187.8016	0.0314
C208	8.1817	3.9807	0.1779
C21	10.1437	3.9271	0.3932
C210	1.0978	1187.8003	0.0317
C23	10.4962	5.8954	0.4951
C310	10.0739	691.2999	9.6741
C340	10.0775	691.2995	9.6774
C401	10.0833	691.3001	9.6807
C402	10.0812	691.2995	9.6812
C414	10.0802	691.2998	9.6795
C421	10.0804	691.2998	9.6799
C425	10.0835	691.3001	9.6837
C441	10.0857	691.3003	9.6859
C5	17.1482	13.3812	4.9144
C500	10.3953	5.2451	0.4803

Environmental Benefit

Cruise Baseline case	Emissions Coefficients (lb/1000lb Fuel)		
	NOx	CO	HC
C501	10.2847	4.6105	0.4533
C550	6.8498	1.8896	0.121
C560	6.8506	1.8905	0.1202
C650	6.8531	1.893	0.1234
C9	8.899	6.6481	2.0358
CA21	8.1909	3.9902	0.1891
CL44	11.6999	5.1	0.5993
CL60	6.8573	1.8965	0.1264
CL61	6.8569	1.896	0.126
CONC	10.1501	26.7136	3.1514
CRJ	6.8558	1.8952	0.1253
CV58	8.1996	3.9978	0.1975
D28	8.186	3.985	0.1845
D328	11.7984	5.0958	0.5954
DA01	8.7463	5.8193	1.7504
DA02	6.8554	1.8949	0.1248
DA05	6.8572	1.8963	0.1263
DA10	9.77	3.61	0.4452
DA20	6.8553	1.8946	0.1245
DC10-10	16.0625	9.1682	3.737
DC10-30	17.0231	10.1836	4.0452
DC3	8.1967	3.9965	0.1961
DC6	7.4898	5.0997	1.9591
DC86	6.4934	28.9813	22.9482
DC8-63	7.0427	17.492	13.2251
DC9-30	9.3504	9.2193	2.9034
DC9-50	10.4412	5.3434	0.7386
DH2	10.0697	691.3011	9.6635
DH3	11.7717	4.9728	0.5707
DH6	12.292	5.0905	0.5901
DH8	11.7989	5.0966	0.5961
E110	8.0926	3.9927	0.192
E120	8.0952	4.0009	0.1942
E2	13	4.2981	0
EA6	10.6827	5.5626	0.4975
F14	7.0799	15.1999	1.1187
F15	10.9999	2.9991	0.5987
F16	10.9993	2.9981	0.5978
F18	10.9999	2.9988	0.5985

Environmental Benefit

Cruise Baseline case	Emissions Coefficients (lb/1000lb Fuel)		
	NOx	CO	HC
FA27	6.8563	1.8954	0.1256
FA28	10.3661	5.6988	0.4895
FFJ	9.5677	3.1729	0.4371
FK10	10.8162	13.3891	1.9261
FK70	11.2306	14.8887	2.0482
G159	12.9997	4.2963	0
G2	6.8594	1.8975	0.1275
G3	6.8595	1.8977	0.1277
G4	6.8595	1.8979	0.1279
G73	11.7787	5.0826	0.5782
HS25	6.8531	1.8929	0.1227
IL96	15.1	38.7999	44.6999
KC35	19.5277	19.8215	7.0717
KE35	18.4355	16.8835	6.0784
KR35	18.4238	16.8523	6.069
L1011	16.4482	14.2388	9.8908
L188	7.4899	5.0998	1.959
L1F	18.1788	25.3817	18.7794
L329	7.2969	8.9987	3.7863
L382	7.4899	5.1	1.9596
LR24	9.6266	3.306	0.4343
LR25	9.8291	3.7372	0.4466
LR31	9.9501	3.9994	0.453
LR35	9.7176	3.4963	0.4429
LR55	9.8237	3.7232	0.4489
LR60	9.6479	3.3449	0.4407
M1F	16.8246	4.9769	0.4316
MD11	15.8242	4.0673	0.3706
MD88	13.8072	5.1978	1.5317
MO20	10.0529	691.299	9.654
MU2	8.3839	3.6837	0.1818
MU3	10.3269	4.8089	0.4714
MU30	10.0979	4.3164	0.4606
N22B	8.1741	3.9789	0.1892
N265	8.7761	5.9766	1.8051
NEWX	20.4828	3.2618	0.2999
P3	7.49	5.1	1.9596
PA23	1.1107	1187.7987	0.031
PA24	1.1048	1187.8018	0.0312

Environmental Benefit

Cruise Baseline case	Emissions Coefficients (lb/1000lb Fuel)		
	NOx	CO	HC
PA28	1.0984	1187.8004	0.0315
PA30	10.0711	691.2996	9.672
PA31	12.2831	5.0825	0.5813
PA32	10.0681	691.2992	9.6678
PA34	10.0703	691.2996	9.6704
PA41	10.8455	5.0143	0.4471
PA42	8.3879	3.5875	0.1894
PA46	10.0663	691.3021	9.6655
PA60	10.0761	691.2997	9.6764
PARO	1.0964	1187.8012	0.0315
PASE	10.0692	691.299	9.6688
PAYE	12.2852	5.0847	0.5854
PAZT	10.0771	691.3	9.677
S20	8.1811	3.9821	0.1871
SF34	6.8959	5.2954	1.4951
SH7	12.2912	5.0901	0.5902
SHD3	7.4858	5.0953	1.955
SW3	9.9088	6.9887	0.6293
SW4	9.9072	6.9872	0.6272
T1	10.6051	5.3999	0.4898
T2	10.4193	4.9992	0.482
T34	10.0794	691.3013	9.6805
T37	10.6915	5.5908	0.4908
T38I	10.6935	5.594	0.4932
TA4	10.6489	5.4946	0.4911
TU34	9.3998	9.3	2.8994
TU5	6.8599	1.8996	0.1295
U21	8.1893	3.9887	0.1883
UH1	7.3482	2.9855	0.2806
UH60	7.3478	2.989	0.2809
WW24	9.7737	3.6136	0.4474
YK4	8.9886	2.6878	0
YS11	6.8598	1.8982	0.1281

Table B-10:Emissions coefficients Cruise, above 3000', phase of flight (an Optimal scenario)

This optimal scenario is defined as:

- Flights flying less than 1,000 nautical miles have their distances reduced (direct routing) when operating at FL240 and above.
- Flights flying greater than 1,000 nautical miles are optimized for minimum fuel when operating at FL240 and above.

For more details see ref [3].

Cruise, Optimal Case	Emissions Coefficients (lb/1000lb Fuel)		
AC Type	NOx	CO	HC
A10	10.6906	5.5792	0.4981
A300	17.7009	8.0191	3.4841
A310	14.8003	4.3566	1.0298
A320	13.2294	4.9453	0.6105
A4	10.6559	5.5069	0.4939
A6	10.6816	5.5602	0.4977
AA5	10.0591	691.2975	9.6596
AC50	10.079	691.2987	9.6749
AC69	8.181	3.9868	0.1858
AJ25	9.4538	2.9289	0.431
AN12	7.4899	5.0994	1.9587
ARJ	6.8598	1.8981	0.1281
AT42	13.0833	4.2993	0
B1	4.8	24.5	4
B52	4.8	24.5	4
B707	11.8697	27.8803	31.4491
B727-200	10.3084	3.6936	0.6061
B737-200	9.7401	4.6812	0.7639
B73F	11.1111	10.1853	0.7211
B73S	11.1786	10.6125	0.8659
B747-100	20.3216	13.7517	7.3394
B747-200	15.8242	9.7974	3.7139
B74F	18.1367	2.1556	0.2996
B74R	19.458	2.7787	0.2996
B757-200	15.3424	7.0694	0.5838
B767-200	15.6775	4.9173	1.0531
B777	12	0.3997	0.1997
BA11	11.166	11.5796	1.4755
BA14	11.3709	12.5973	1.5794
BA31	8.1916	3.9926	0.1916

Environmental Benefit

Cruise, Optimal Case	Emissions Coefficients (lb/1000lb Fuel)		
AC Type	NOx	CO	HC
BA41	8.1907	4.0127	0.1978
BA46	8.461	5.5347	0.552
BATP	8.1991	3.9975	0.1969
BE02	8.1799	3.9968	0.1931
BE10	10.088	691.2997	9.6883
BE18	1.1274	1187.8004	0.0301
BE20	10.0884	691.2998	9.6884
BE30	8.0937	4.4123	0.2748
BE33	10.0634	691.2995	9.664
BE35	1.0916	1187.7995	0.0318
BE36	10.0659	691.2998	9.6653
BE3B	7.8041	5.8018	0.5559
BE40	9.8363	3.7551	0.4454
BE55	10.0754	691.2999	9.6752
BE58	10.0769	691.2994	9.6763
BE60	10.0796	691.298	9.678
BE76	10.0677	691.2976	9.6698
BE8T	10.0867	691.3002	9.6862
BE90	10.0847	691.2997	9.6847
BE99	10.0897	691.3002	9.6892
BN2	10.084	691.2991	9.6818
C12	8.1889	3.8916	0.1903
C130	7.49	5.1	1.9599
C141	7.3	9	3.79
C152	1.069	1187.8041	0.0205
C172	1.0891	1187.7995	0.0308
C177	1.0969	1187.7996	0.0311
C182	1.1008	1187.7995	0.0316
C206	1.1125	1187.8016	0.0313
C208	8.1815	3.9801	0.1769
C21	10.1221	3.8126	0.3877
C210	1.0977	1187.8003	0.0317
C23	10.4961	5.8954	0.4951
C310	10.0721	691.2999	9.6728
C340	10.0772	691.2995	9.6771
C401	10.0832	691.2999	9.6807
C402	10.0808	691.2994	9.6812
C414	10.0801	691.2997	9.6795
C421	10.0798	691.2998	9.6794

Environmental Benefit

Cruise, Optimal Case	Emissions Coefficients (lb/1000lb Fuel)		
AC Type	NOx	CO	HC
C425	10.0829	691.2998	9.6833
C441	10.0839	691.2998	9.6844
C5	16.9943	12.9645	4.7748
C500	10.3134	4.7288	0.4666
C501	10.2626	4.4801	0.4482
C550	6.8487	1.8883	0.12
C560	6.8495	1.8894	0.1195
C650	6.8525	1.8924	0.1224
C9	8.8628	6.4425	1.9661
CA21	8.1906	3.9893	0.1888
CL44	11.6999	5.1	0.5993
CL60	6.8567	1.8961	0.1261
CL61	6.8565	1.8958	0.1256
CONC	10.1501	26.7136	3.1514
CRJ	6.8548	1.8944	0.1245
CV58	8.1991	3.9973	0.1973
D28	8.186	3.985	0.1845
D328	11.7721	5.0958	0.5908
DA01	8.6987	5.5542	1.6606
DA02	6.8546	1.894	0.1245
DA05	6.8567	1.8957	0.126
DA10	9.7107	3.4834	0.4415
DA20	6.8544	1.894	0.1243
DC10-10	15.5689	8.1748	3.4039
DC10-30	17.0231	10.1836	4.0452
DC3	8.1965	3.9963	0.196
DC6	7.4898	5.0997	1.9591
DC86	6.4622	28.3665	22.3515
DC8-63	7.0427	17.492	13.2251
DC9-30	8.9972	7.2097	2.2244
DC9-50	10.2975	4.9235	0.7053
DH2	10.0629	691.3	9.6635
DH3	11.7717	4.9728	0.5655
DH6	12.2912	5.09	0.5896
DH8	11.7756	5.0966	0.5915
E110	8.0915	3.9909	0.1909
E120	8.0936	4.0009	0.1928
E2	12.9999	4.2981	0
EA6	10.6827	5.5626	0.4975

Environmental Benefit

Cruise, Optimal Case	Emissions Coefficients (lb/1000lb Fuel)		
AC Type	NOx	CO	HC
F14	7.0797	15.1998	1.1185
F15	10.9998	2.9991	0.5987
F16	10.9993	2.9981	0.5978
F18	10.9998	2.9987	0.5985
FA27	6.8522	1.8921	0.123
FA28	10.134	5.1776	0.4772
FFJ	9.5677	3.1729	0.4371
FK10	10.4323	12.0009	1.813
FK70	10.5228	12.3312	1.8389
G159	12.9997	4.2962	0
G2	6.8591	1.8972	0.1272
G3	6.8592	1.8974	0.1274
G4	6.8593	1.8977	0.1277
G73	11.7787	5.0826	0.5782
HS25	6.852	1.8916	0.1219
IL96	15.1	38.7999	44.6999
KC35	19.4624	19.6449	7.0126
KE35	18.3314	16.6038	5.9847
KR35	18.3388	16.6224	5.9919
L1011	16.4482	14.2388	9.8908
L188	7.4899	5.0998	1.959
L1F	18.1788	25.3817	18.7794
L329	7.2966	8.998	3.7861
L382	7.4899	5.1	1.9596
LR24	9.5774	3.202	0.4302
LR25	9.7883	3.6522	0.4431
LR31	9.8709	3.8263	0.4489
LR35	9.6597	3.3732	0.4391
LR55	9.709	3.4778	0.4422
LR60	9.5728	3.183	0.4364
M1F	16.8246	4.9769	0.4316
MD11	15.8242	4.0673	0.3706
MD88	13.0816	4.8712	1.4772
MO20	10.0525	691.2984	9.6536
MU2	8.3836	3.6835	0.1816
MU3	10.3269	4.8089	0.4708
MU30	10.0979	4.3164	0.4606
N22B	8.1741	3.9789	0.1892
N265	8.7372	5.758	1.7308

Environmental Benefit

Cruise, Optimal Case	Emissions Coefficients (lb/1000lb Fuel)		
AC Type	NOx	CO	HC
NEWX	19.181	2.648	0.2996
P3	7.49	5.1	1.9596
PA23	1.1107	1187.7987	0.031
PA24	1.1048	1187.8005	0.0311
PA28	1.0984	1187.8004	0.0314
PA30	10.0711	691.299	9.672
PA31	12.2827	5.0822	0.5812
PA32	10.0681	691.2992	9.6678
PA34	10.0702	691.2993	9.6704
PA41	10.7912	5.0092	0.4413
PA42	8.3864	3.5867	0.1879
PA46	10.0655	691.3009	9.6645
PA60	10.0761	691.2997	9.6764
PARO	1.0964	1187.8012	0.0311
PASE	10.0687	691.2985	9.6685
PAYE	12.285	5.0843	0.5852
PAZT	10.0762	691.3	9.6764
S20	8.1811	3.9821	0.1871
SF34	6.8946	5.2943	1.4941
SH7	12.2893	5.089	0.5889
SHD3	7.4841	5.0939	1.954
SW3	9.9086	6.9887	0.6292
SW4	9.9043	6.9845	0.6251
T1	10.601	5.3906	0.4898
T2	10.4009	4.9594	0.4812
T34	10.0786	691.3008	9.6805
T37	10.6914	5.5908	0.4908
T38I	10.6935	5.594	0.4932
TA4	10.4529	5.0758	0.4803
TU34	9.3998	9.3	2.8994
TU5	6.8597	1.8996	0.1293
U21	8.1893	3.9886	0.1883
UH1	7.3482	2.9855	0.2806
UH60	7.3478	2.9888	0.2809
WW24	9.6911	3.438	0.4426
YK4	8.9886	2.6878	0
YS11	6.8596	1.8977	0.1278

Table B-11:Emissions coefficients Cruise, above 3000', phase of flight (an Optimal scenario)

This optimal scenario is defined as:

- Flights flying less than 1,000 nautical miles have their distances reduced (direct routing) when operating at 15,000 feet and above.
- Flights flying greater than 1,000 nautical miles are optimized for minimum fuel when operating at 15,000 feet and above.

For more details see ref [3].

Cruise Optimal case	Emissions Coefficients (kg/1000kg Fuel)		
AC type	NOx	CO	HC
A10	10.6906	5.5792	0.4981
A300	17.2537	6.7817	3.022
A310	14.6056	4.1451	0.9834
A320	13.0864	4.7609	0.603
A4	10.6552	5.5061	0.4935
A6	10.6828	5.5629	0.4978
AA5	10.0591	691.2978	9.6596
AC50	10.0791	691.2985	9.6746
AC69	8.1796	3.9868	0.1858
AJ25	9.4661	2.9557	0.4306
AN12	7.4899	5.0994	1.9587
ARJ	6.8598	1.8981	0.1281
AT42	13.0091	4.3018	0
B1	4.8	24.5	4
B52	4.8	24.5	4
B707	10.8383	24.3939	27.3462
B727-200	10.3084	3.6936	0.6061
B737-200	9.5918	4.5807	0.7591
B73F	10.8569	9.061	0.633
B73S	11.0552	10.0098	0.8137
B747-100	19.0806	11.1714	6.0369
B747-200	16.4866	11.5903	4.3144
B74F	17.3921	1.8046	0.2996
B74R	16.7961	1.5237	0.2997
B757-200	14.7214	6.556	0.5241
B767-200	15.1383	4.5749	0.9761
B777	12	0.3996	0.1996
BA11	11.1782	11.6334	1.4818
BA14	11.3723	12.6105	1.5796

Environmental Benefit

Cruise Optimal case	Emissions Coefficients (kg/1000kg Fuel)		
AC type	NOx	CO	HC
BA31	8.1912	3.9919	0.1903
BA41	8.1371	4.0171	0.1981
BA46	8.3024	4.423	0.4371
BATP	8.1984	3.9967	0.1964
BE02	8.1858	3.9968	0.1926
BE10	10.0867	691.2998	9.6869
BE18	1.1275	1187.8	0.0301
BE20	10.087	691.2998	9.6869
BE30	8.0924	4.4123	0.2748
BE33	10.0635	691.2993	9.664
BE35	1.0916	1187.8	0.0318
BE36	10.0657	691.2998	9.6649
BE3B	7.8043	5.8018	0.5559
BE40	9.8061	3.6919	0.4438
BE55	10.075	691.2999	9.6753
BE58	10.0763	691.2998	9.6759
BE60	10.0776	691.298	9.6782
BE76	10.0674	691.2976	9.6698
BE8T	10.0867	691.2999	9.6863
BE90	10.0832	691.2997	9.6829
BE99	10.089	691.3002	9.6888
BN2	10.084	691.299	9.6818
C12	8.1885	3.89	0.1897
C130	7.4899	5.0999	1.9598
C141	7.3	9	3.7899
C152	1.069	1187.804	0.0185
C172	1.0891	1187.8	0.0306
C177	1.0969	1187.799	0.0312
C182	1.1008	1187.799	0.0315
C206	1.1107	1187.802	0.0309
C208	8.1815	3.9801	0.1769
C21	10.1228	3.8284	0.3876
C210	1.0977	1187.8	0.0317
C23	10.4961	5.8954	0.4951
C310	10.0709	691.2995	9.6707
C340	10.0767	691.2993	9.6768
C401	10.0823	691.2997	9.6807
C402	10.0801	691.299	9.6808
C414	10.0788	691.2998	9.6784

Environmental Benefit

Cruise Optimal case	Emissions Coefficients (kg/1000kg Fuel)		
AC type	NOx	CO	HC
C421	10.0793	691.2995	9.6791
C425	10.0809	691.3	9.6808
C441	10.083	691.3	9.6831
C5	16.9746	12.9113	4.757
C500	10.3111	4.7138	0.4664
C501	10.2623	4.4844	0.4474
C550	6.8477	1.8876	0.1194
C560	6.8484	1.8887	0.1192
C650	6.8517	1.8918	0.1222
C9	8.8627	6.4424	1.966
CA21	8.1904	3.9897	0.1889
CL44	11.6999	5.1	0.5993
CL60	6.8565	1.8958	0.126
CL61	6.8562	1.8955	0.1258
CONC	10.1501	26.7136	3.1514
CRJ	6.8547	1.8943	0.1245
CV58	8.1988	3.9972	0.1967
D28	8.186	3.985	0.1845
D328	11.777	5.0958	0.5909
DA01	8.7152	5.6504	1.6928
DA02	6.8542	1.8942	0.1241
DA05	6.8564	1.8956	0.1256
DA10	9.7216	3.5081	0.4415
DA20	6.8537	1.8935	0.1237
DC10-10	14.6501	6.3258	2.7837
DC10-30	16.6966	9.5869	3.8427
DC3	8.1966	3.9964	0.1961
DC6	7.4897	5.0997	1.9588
DC86	6.3732	26.6091	20.6456
DC8-63	7.0427	17.492	13.2251
DC9-30	8.9478	6.9287	2.1295
DC9-50	10.2149	4.6821	0.6862
DH2	10.0629	691.3	9.6635
DH3	11.7717	4.9728	0.5655
DH6	11.7818	5.0654	0.5412
DH8	11.7856	5.0954	0.5927
E110	8.0914	3.9918	0.19
E120	8.0916	4.0009	0.1912
E2	12.9996	4.2977	0

Environmental Benefit

Cruise Optimal case	Emissions Coefficients (kg/1000kg Fuel)		
AC type	NOx	CO	HC
EA6	10.6827	5.5626	0.4975
F14	7.0796	15.1998	1.1184
F15	10.9998	2.999	0.5987
F16	10.9992	2.998	0.5978
F18	10.9997	2.9986	0.5983
FA27	6.8523	1.8922	0.1232
FA28	10.0816	5.0597	0.4744
FFJ	9.5677	3.1729	0.4371
FK10	10.0569	10.6429	1.7023
FK70	10.5228	12.3312	1.8389
G159	12.9987	4.2955	0
G2	6.859	1.897	0.127
G3	6.8591	1.8973	0.1273
G4	6.8591	1.8974	0.1274
G73	11.7787	5.0826	0.5782
HS25	6.8522	1.8916	0.122
IL96	15.1	38.7999	44.6999
KC35	19.4647	19.6512	7.0147
KE35	18.3235	16.583	5.9775
KR35	18.3536	16.6635	6.0055
L1011	16.1656	12.4381	8.4536
L188	7.4898	5.0997	1.9587
L1F	18.1788	25.3817	18.7794
L329	7.2965	8.998	3.7856
L382	7.4898	5.0997	1.959
LR24	9.5628	3.1731	0.4291
LR25	9.7351	3.5394	0.4401
LR31	9.8832	3.8566	0.4491
LR35	9.657	3.3683	0.4385
LR55	9.7782	3.6278	0.4451
LR60	9.5777	3.1948	0.4374
M1F	14.1187	2.517	0.2676
MD11	15.2279	3.5252	0.3345
MD88	12.7818	4.7363	1.4547
MO20	10.0527	691.2983	9.654
MU2	8.3825	3.682	0.1814
MU3	10.2587	4.6646	0.4663
MU30	9.8994	3.8946	0.4477
N22B	8.1741	3.9789	0.1892

Environmental Benefit

Cruise Optimal case	Emissions Coefficients (kg/1000kg Fuel)		
AC type	NOx	CO	HC
N265	8.7213	5.6704	1.7012
NEWX	17.0583	1.6473	0.2996
P3	7.4899	5.0999	1.9595
PA23	1.1107	1187.799	0.031
PA24	1.1048	1187.8	0.0312
PA28	1.0984	1187.8	0.0313
PA30	10.0711	691.2992	9.672
PA31	12.2826	5.0822	0.5811
PA32	10.0681	691.2992	9.6678
PA34	10.0696	691.2992	9.67
PA41	10.7928	5.0099	0.4395
PA42	8.3847	3.5844	0.1865
PA46	10.0635	691.3013	9.6643
PA60	10.0714	691.299	9.6708
PARO	1.0963	1187.801	0.0311
PASE	10.0689	691.2981	9.6687
PAYE	12.2832	5.0828	0.5832
PAZT	10.0764	691.2996	9.6768
S20	8.1811	3.9821	0.1871
SF34	6.8936	5.2933	1.4932
SH7	12.2859	5.085	0.5863
SHD3	7.4825	5.0928	1.9523
SW3	9.9069	6.9866	0.6268
SW4	9.9023	6.9823	0.6227
T1	10.5937	5.3769	0.4887
T2	10.401	4.9591	0.4812
T34	10.0786	691.3008	9.6805
T37	10.6913	5.5902	0.4905
T38I	10.6935	5.594	0.4932
TA4	10.4586	5.0882	0.4799
TU34	9.3998	9.3	2.8994
TU5	6.8597	1.8991	0.1287
U21	8.1893	3.9886	0.1883
UH1	7.3482	2.9855	0.2806
UH60	7.3478	2.9888	0.2809
WW24	9.7372	3.5371	0.4446
YK4	8.9886	2.6878	0
YS11	6.8596	1.8977	0.1278

Environmental Benefit